Final report

OWMC
Ontario
Waste Management
Corporation

A provincial crown corporation

Gartner
Lee
Associates
Limited

SITE SELECTION PROCESS - PHASE 4A

TECHNICAL APPENDIX

SURFACE WATER CONSIDERATIONS

A REPORT PREPARED FOR
ONTARIO WASTE MANAGEMENT CORPORATION
BY
GARTNER LEE ASSOCIATES LIMITED

THIS REPORT IS THE TECHNICAL APPENDIX DESCRIBING SURFACE WATER CONDITIONS OF THE CANDIDATE SITES. IT SUPPORTS THE COMPARATIVE EVALUATION STUDY REPORT WHICH IS ENTITLED "SITE SELECTION PROCESS .PHASE 4A: SELECTION OF A PREFERRED SITE(S) - SURFACE WATER"

OCTOBER, 1985

PROJECT NO: 85-S18.6

Gartner Lee
Associates Limited

Gartner Lee Associates Limited

Consulting Engineering
Geologists
Biologists and
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October 24, 1985.

Dr. B.D. Mitchell,
Director of Corporate Planning
and Development,
Ontario Waste Management Corporation,
2 Bloor Street West,
11th Floor,
Toronto, Ontario.
M4W 3E2.

Attention: Mr. J.G. Micak,
Manager,
Environmental Projects.

Dear Dr. Mitchell:

Re: Site Selection Process, Phase 4A: Technical Appendix
Surface Water Considerations

We are forwarding the Phase 4A Technical Appendix which describes surface water considerations on and in the vicinity of the Candidate Sites.

This technical appendix provides the basic surface water data to allow the comparative evaluation of the eight candidate sites. For a full understanding of how surface water considerations of the candidate sites were compared and the factors applied during Phase 4A, you are referred to the main text of this report entitled "Site Selection Process, Phase 4A: Selection of a Preferred Site(s) - Surface Water".

We thank you for this opportunity to be of service and trust that this report meets the Corporation's requirements.

Yours very truly,

GARTNER LEE ASSOCIATES LIMITED

E.G. Anderson, P.Eng.,
Project Director.

JEO:jcm
Enclosure.

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STUDY TEAM

This study was carried out under the direction of Grant Anderson, Project Director, Gartner Lee Associates Limited (GLAL). The study team included:

Project Director	Ted O'Neill
Technical Advisor	David Osmond
Project Hydrologist	Craig MacRae
Project Hydrologist	James McLean

The flooding and drainage portion of this study was undertaken by Messrs. Allan Mitchell and Wayne Concessi of M.M. Dillon Limited.

1.0 INTRODUCTION

1.1 BACKGROUND

The Ontario Waste Management Corporation (OWMC) is conducting a five-phase "Facilities Development Process" to establish facilities for the treatment and disposal of liquid industrial and hazardous wastes ("special wastes") in the Province. This process has resulted in the identification of eight* candidate sites for development of various facility components within the Golden Horseshoe of southern Ontario. Candidate site locations are shown in Figure 1.

Phase 4A (the present study phase) involves the detailed comparison of the eight candidate sites and the identification of a preferred siting option. Phase 4B will involve detailed on-site testing of the selected site(s).

1.2 REPORT PURPOSE AND ORGANIZATION

Phase 4A reporting on surface water resources of the eight candidate sites is presented in two volumes. The main volume of this report (Site Selection Process, Phase 4A: Selection of a Preferred Site(s) - Surface Water; GLAL, 1985a) describes the site selection process and compares each of the sites on the

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*Candidate Site LF-2N was removed from consideration on 31 May, 1985, due to its failure to meet basic hydrogeologic acceptability considerations (Site Selection, Process Phase 4A: Selection of a Preferred Site(s) - Interim Site Selection Report Candidate Site LF-2N; M.M. Dillon Limited, 1985a)

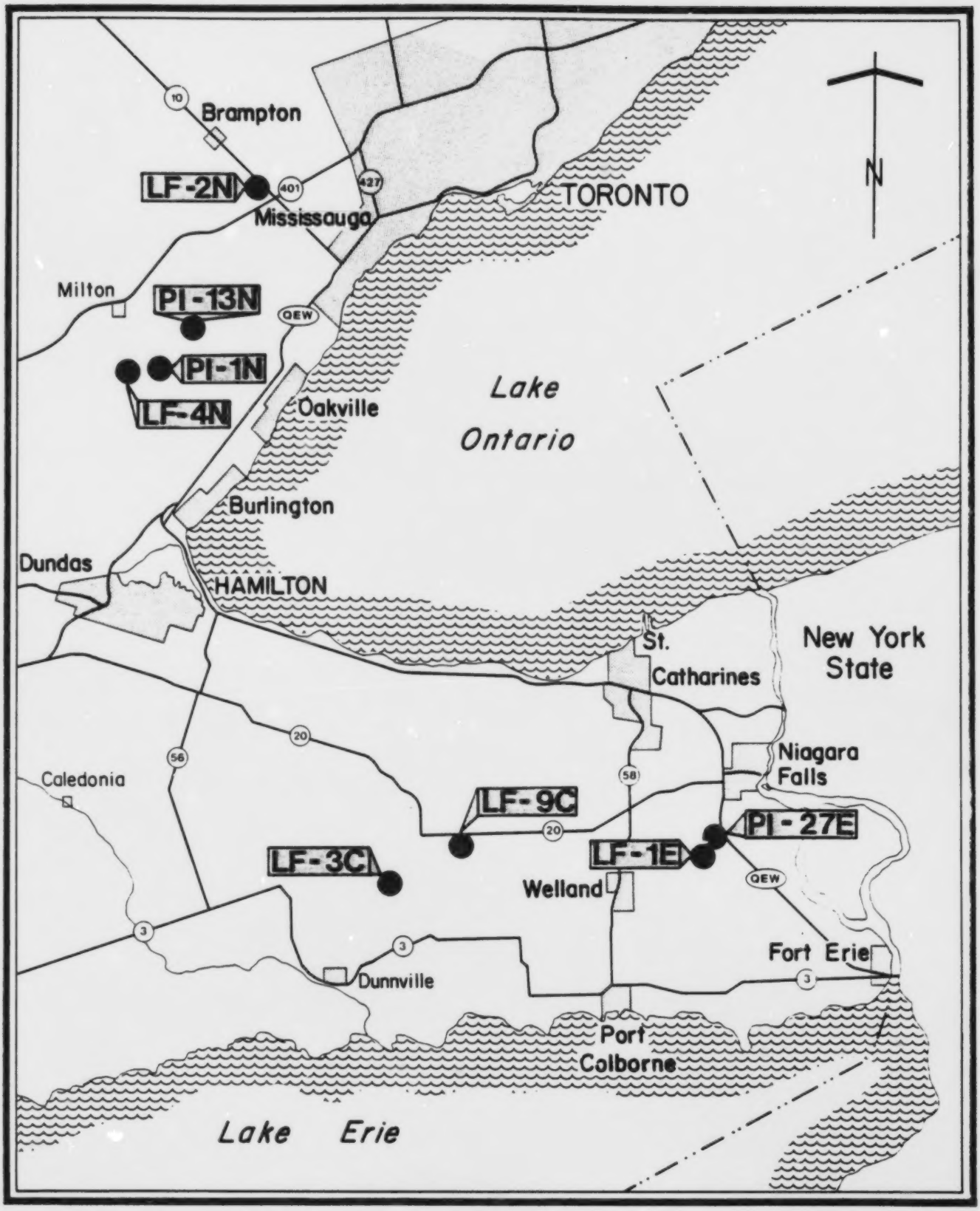

FIGURE 1 LOCATION OF CANDIDATE SITES

basis of surface water considerations. It includes a discussion of access road options, rail access options, site boundary refinement, the location of the physical/chemical treatment plant for partially integrated options and facility siting options. It also includes a discussion of factors and indicators used in comparing options, and the conclusions and recommendations resulting from the detailed comparative evaluation.

This Technical Appendix describes existing conditions at the eight candidate sites with respect to surface water. A detailed description of the methods used for data collection and analysis is presented with a discussion of the study findings. Data maps and data summaries for candidate sites are also included. Data are presented for alternative access roads. The choices available for drainage improvements at each site are also discussed. Sections 1 and 2 are introductory, defining study areas and describing data collection methods. Sections 3 to 10 describe existing surface water conditions around the eight candidate sites. The Appendix lists government agencies and site groups contacted during this phase, and a copy of the surface water section of a questionnaire used during the study.

This Appendix is written as a data base of existing conditions and a discussion of different solutions to some of the points of concern encountered during the data collection. The comparative evaluation of the data and the consideration of options is dealt with in the main volume of this report (GLAL, 1985a).

1.3 STUDY OBJECTIVES AND SCOPE

A surface water study was undertaken by Gartner Lee Associates Limited (GLAL) as part of OWMC's Phase 4A site selection process.

The objectives of the study were:

- to collect and analyse information concerning the surface water resources of the eight candidate sites and their vicinities;

- to provide input on surface water issues to OWMC's detailed comparative evaluation of the candidate sites and siting options leading to the identification of a preferred site or set of sites; and

- to provide preliminary input to the facility design process on surface water issues.

Phase 4A surface water investigations were designed to bridge the gap between the regional scale investigation that took place in Phase 3 and the detailed on-site testing that is recommended to take place in Phase 4B, once a preferred siting option has been identified. Since the intent of data collection and analysis tasks in Phase 4A was to permit a comparative evaluation among sites, reliance was placed on existing data sources available from municipal and provincial agencies. This data base was supplemented by public contact, limited field studies and standard analytical techniques.

Data sources for the surface water study included topographic maps, aerial photographs, published reports, open files and personal communications with numerous municipal and provincial agency staff. Information was obtained through questionnaires, meetings with local interest groups, site tours with knowledgeable local residents and roadside field investigations. The collection of detailed data, e.g. flooding

and surface water uses, was restricted to the site and site vicinity. Information collected downstream from the site vicinity limit (study area boundary), and downstream from access route crossings was of a less detailed nature.

Data analysis tasks were undertaken for the following major areas of study:

- flood hazard;
- drainage improvement considerations; and
- potential impact on surface water usage.

The analysis techniques used included:

- the interpretation of flood-prone areas from aerial photographs;
- the calculation of runoff potential for storms of various return periods;
- the calculation of the conveyance capacity of existing culverts and bridges;
- the preparation of various data summaries and maps depicting technical information and spatial relationships; and
- measurement of access road lengths, stream lengths, and stream crossing widths.

1.4 LOCATION OF CANDIDATE SITES

The location of the eight candidate sites announced by OWMC in March, 1984 is shown on Figure 1. A brief description of the location of each candidate site and its site boundary is given in the following subsection.

It should be noted that the site boundaries described in the following subsections were identified by the site selection team at the end of Phase 3B (Phase 3 Report Summary; OWMC, 1984a). During Phase 4A boundaries for sites LF-1E, PI-1N and LF-3C were modified. The surface water investigations reported in this volume are based on the Phase 3B Acquisition Boundaries.

1.4.1 LF-2N*

Candidate site LF-2N is located in the City of Mississauga approximately 7 km southeast of downtown Brampton and approximately 3 km southwest of Pearson International Airport. It covers approximately 172 ha and includes Lot 9 and Lot 10, Concession 1 EHS in the City of Mississauga.

The northern property boundary is delineated by Derry Road East. The western boundary is Hwy 10 (Hurontario Street), beginning at Derry Road East and running southeast approximately 1.5 km toward Hwy 401 (MacDonald-Cartier Freeway). The southern boundary is parallel to Derry Road East between Hurontario and First Line East approximately 1.5 km south of Derry Road. The eastern property boundary is the First Line East. The location of this site is shown on Figure 2.

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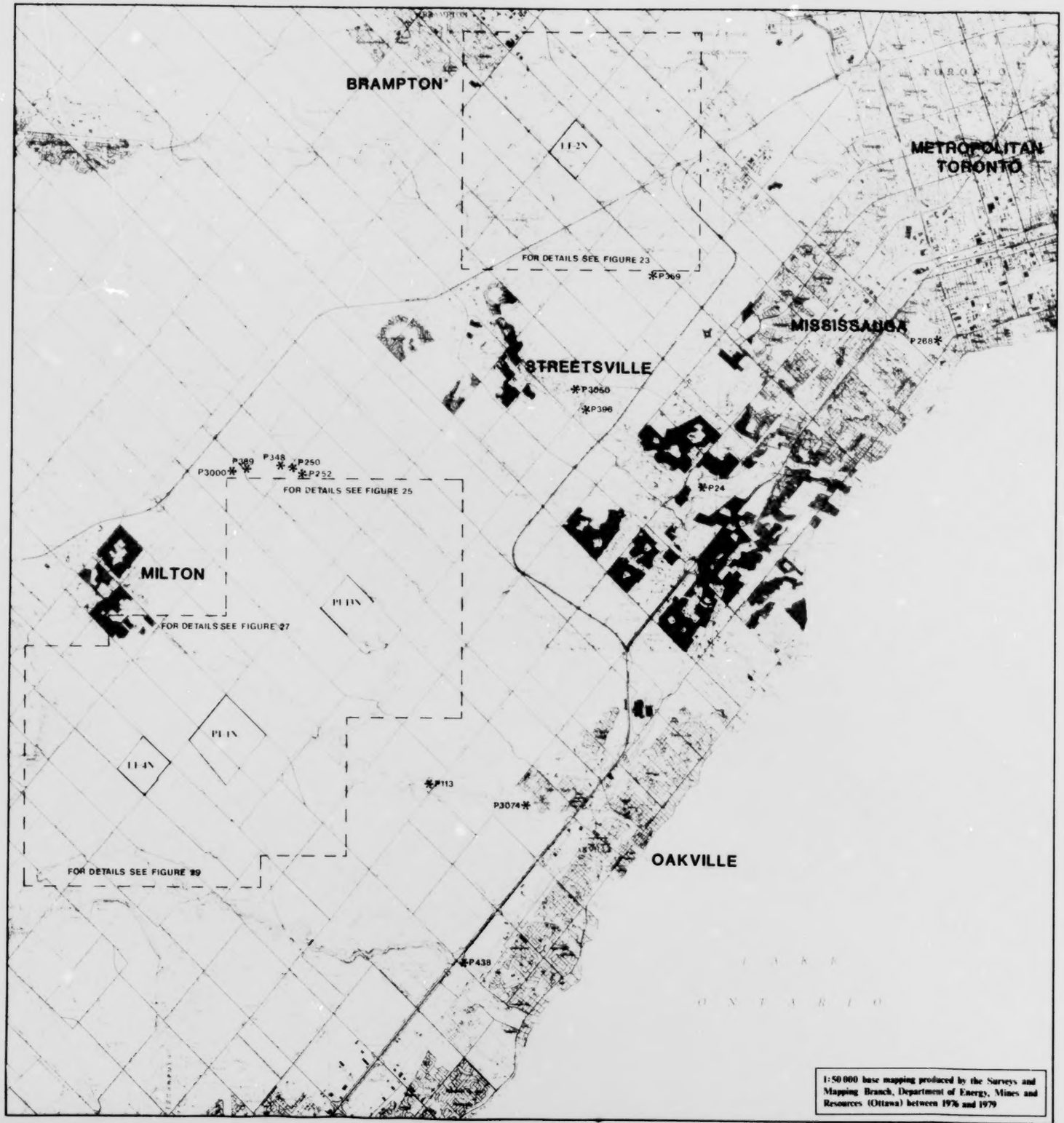
*Candidate Site LF-2N was removed from consideration on 31 May, 1985, due to its failure to meet basic hydrogeologic acceptability considerations (Site Selection, Process Phase 4A: Selection of a Preferred Site(s) - Interim Site Selection Report Candidate Site LF-2N; M.M. Dillon Limited, 1985a)



1:50 000 base mapping produced by the Surveys and Mapping Branch, Department of Energy, Mines and Resources (Ottawa) between 1976 and 1979

OWMC Ontario Waste Management Corporation

Consultant: Gartner Lee Associates Limited

Legend

- Municipal Intake
- Municipal Outfall
- Industrial Intake
- Industrial Outfall
- B Recreation: B beaches, W Winter Sports, S swimming, P Pond, Bt boating
- Rural Potable Supply
- Nonpotable Domestic Supply
- Livestock Watering (stream or pond)
- Irrigation - PTTMOE Permit To Take Water
- P Farm Pond Unspecified Use or Unused
- U Stream Taking Unspecified

Key Map:

Sources Notes

mile	0	1	2	3	miles
metres 1000	0	1	2	3	4	kilometres

EXISTING SURFACE WATER CONDITIONS, PHASE 4A

Regional Water Use
PI-1N, LF-2N, LF-4N, PI-13N

October 1985 **FIGURE 2**

1.4.2 PI-13N

Candidate site PI-13N is located in the Region of Halton approximately 6 km east of downtown Milton (Hwy 25 and Main Street) and approximately 18 km northeast of Oakville. The site covers approximately 170 ha and includes Lot 3 and Lot 4, Concession 6, Town of Milton, (formerly Township of Trafalgar), Regional Municipality of Halton.

The site lies between Fifth Line and Sixth Line, south of Britannia Road West. The northern and southern boundary lines are parallel to and approximately 0.75 km and 1.9 km, respectively, south of Britannia Road. The location of this site is shown on Figure 2.

1.4.3 PI-1N

Candidate site PI-1N is located in the Regional Municipality of Halton, approximately 5 km southeast of Milton. The site covers approximately 378 ha on Lots 3, 4 and 5, Concession I, Town of Milton (formerly Township of Trafalgar) and Lots 3, 4 and 5, Concession 2, Town of Milton.

The northwestern and northeastern site boundaries are Britannia Road and Bronte Road (Highway 25), respectively. The southwestern property border is the CNR railway line and the southeastern boundary is parallel to and and approximately 1.9 km southeast of Britannia Road. The location of this site is shown on Figure 2.

1.4.4 LF-4N

Candidate site LF-4N is located in the Regional Municipality of Halton approximately 5 km south of Milton. The site covers approximately 168 ha and includes Lot 6 and Lot 7, Concession 7, Town of Milton, (formerly Town of Nelson).

The site is bounded by Bell School Line on the west, Britannia Road to the south and Tremaine Road on the east. The northern property boundary runs parallel to, and approximately 1.3 km to the north of Britannia Road. The location of this site is shown on Figure 2.

1.4.5 LF-3C

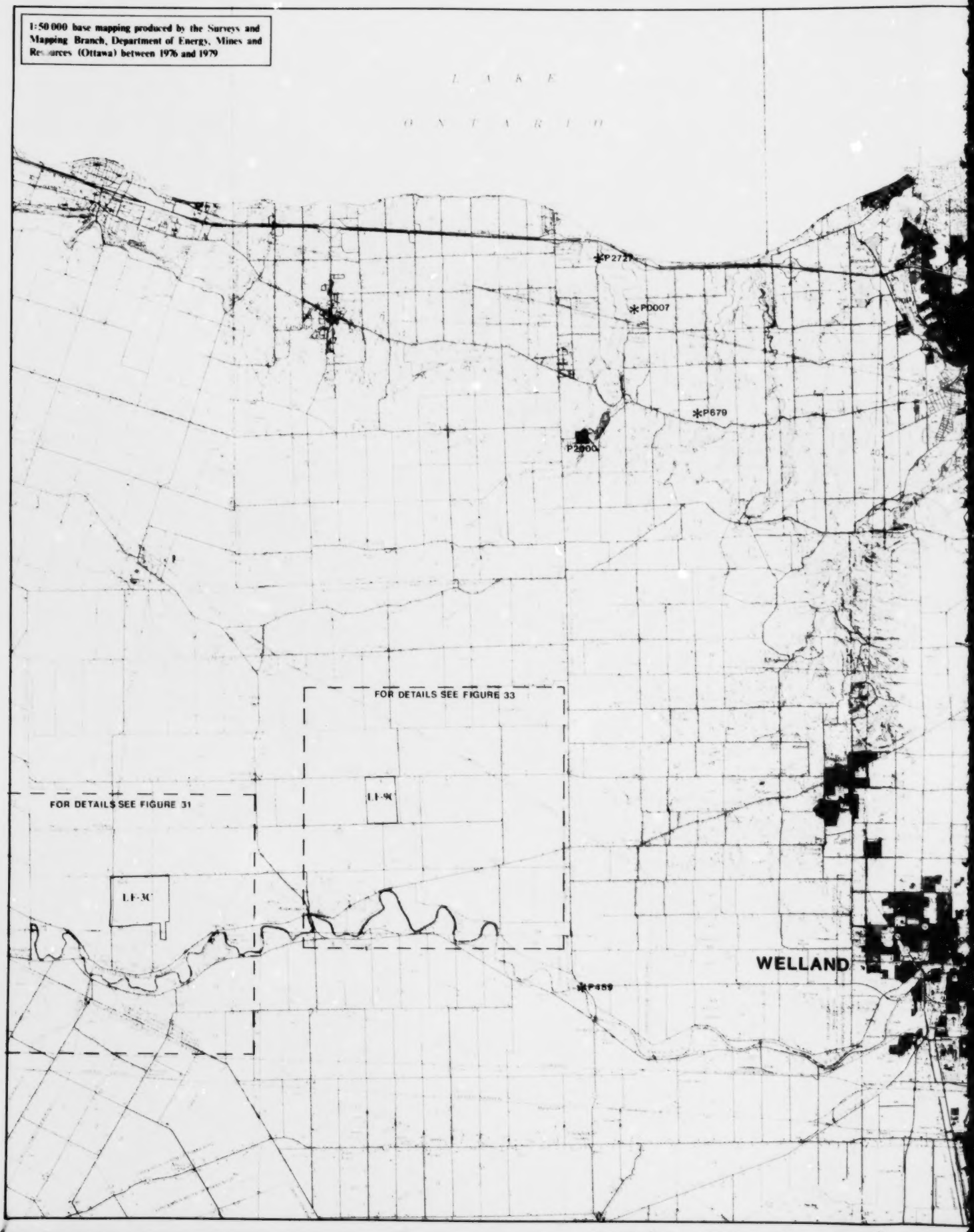
Candidate site LF-3C is located in the Regional Municipality of Niagara, approximately midway between Hamilton and Fort Erie, approximately 5 km southwest of Bismarck and 5 km west of Wellandport. The site covers approximately 259 ha and includes parts of Lot 5, Lot 6 and Lot 7, Concession 7 in West Lincoln Township (formerly Township of Gainsborough).

The site is bounded by Zumstein Road to the south, Vaughan Road to the west and Elcho Road to the north. The eastern property boundary runs parallel to and approximately 1.8 km to the east of Vaughan Road. The location of this site is shown on Figure 3.

1.4.6 LF-9C

Candidate site LF-9C is located in the Regional Municipality of Niagara, approximately 20 km southwest of St. Catharines, 4 km east of Bismarck and 4 km northeast of Wellandport. The site covers approximately 135 ha and is located on parts of Lot 17 and Lot 18, Concession 3, Township of West Lincoln (formerly Township of Gainsborough).

The site is bounded by Hwy 20 to the north, Schram Road on the east and Vaughan Road East on the south. The western property boundary follows a line parallel to and approximately 0.9 km to the west of Schram Road. The location of this site is shown on Figure 3.


1:50 000 base mapping produced by the Surveys and Mapping Branch, Department of Energy, Mines and Resources (Ottawa) between 1976 and 1979
LAKE
ONTARIO
P272
PD007
P679
P2000
FOR DETAILS SEE FIGURE 33
FOR DETAILS SEE FIGURE 31
LF-9
LF-3
WELLAND
P459

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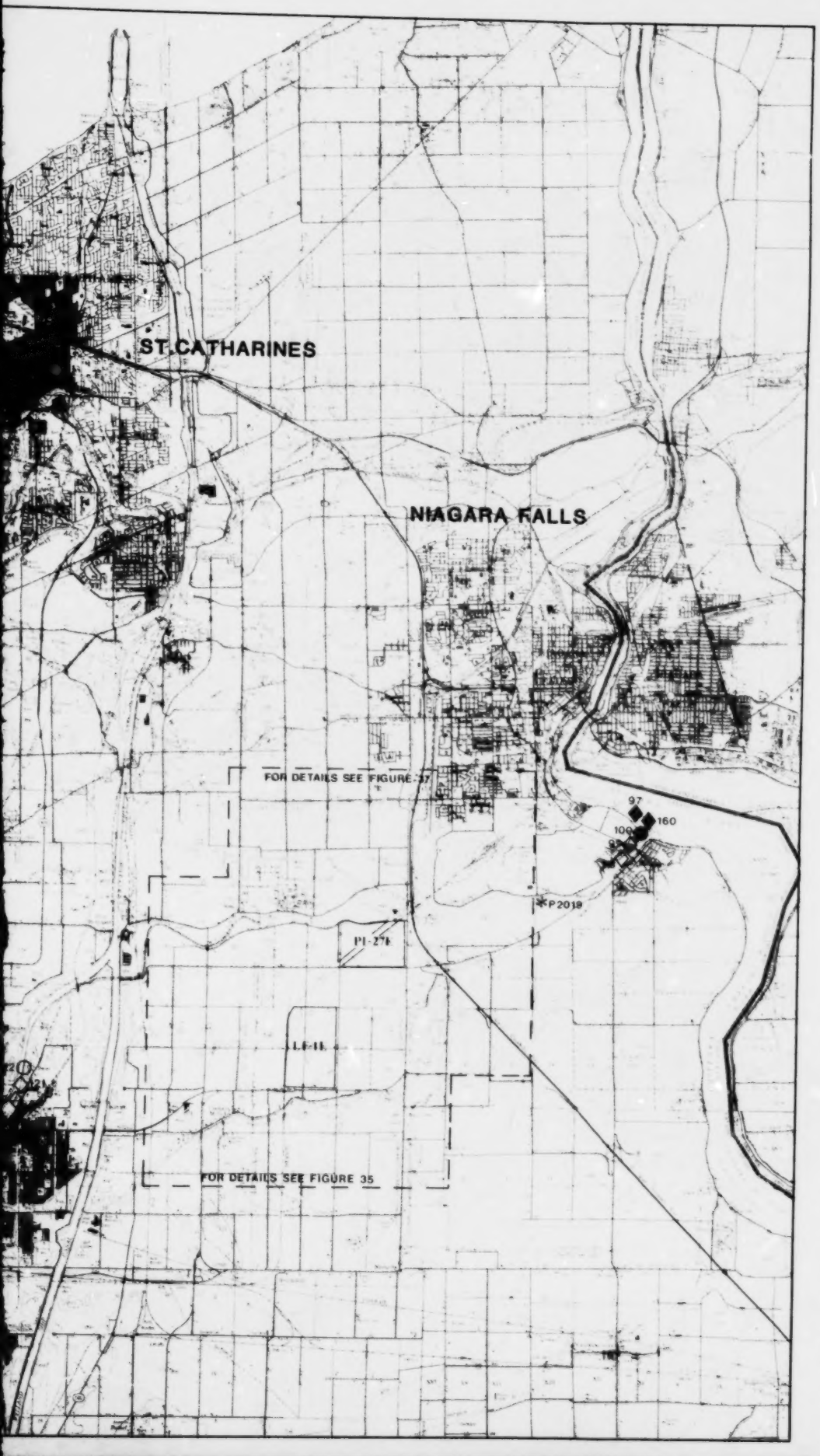

Legend

- Municipal Intake
- Municipal Outfall
- Industrial Intake
- Industrial Outfall
- B Recreation: B - beaches, S - swimming, Bt - boating, W - Winter Sports, P - Pond
- Rural Potable Supply
- Nonpotable Domestic Supply
- Livestock Watering (stream or pond)
- Irrigation - P71 MOE. Permit To Take Water
- P Farm Pond Unspecified Use or Unused
- U Stream Taking Unspecified

Key Map:

Sources/Notes

mile 1 0 1 2 3 miles
metres 1000 0 1 2 3 4 kilometres

EXISTING SURFACE WATER CONDITIONS, PHASE 4A

Regional Water Use
LF-3C, LF-9C, LF-1E, PI-27E

October 1985 **FIGURE 3**

1.4.7 LF-1E

Candidate site LF-1E is located in the City of Niagara Falls approximately 4 km southwest of the QEW bridge over the Welland River, within the City Limits. The site covers approximately 273 ha of Lot 4, Lot 5 and Lot 7, Concessions 2 and 3, City of Niagara Falls (formerly Township of Crowland).

The site is bounded by Carl Road to the north, Crowland Avenue to the east and Schisler Road to the south. The western property boundary is parallel to and approximately 1.3 km west of Crowland Avenue. The location of this site is shown on Figure 3.

1.4.8 PI-27E

Candidate site PI-27E is located in the City of Niagara Falls 1 km southwest of the QEW bridge over the Welland River. The site covers 188 ha of parts of Lot 1, Lot 2, Lot 3 and Lot 4, Broken Front Concession, City of Niagara Falls (formerly Township of Crowland).

The site is bounded by Crowland Avenue to the west, Biggar Road to the south, Montrose Road to the east and Grassy Brook Road to the north. The location of this site is shown on Figure 3.

1.5 FACILITY COMPONENT OPTIONS

The facility component options are summarized in Table 1.

TABLE 1 SUMMARY OF PROPOSED FACILITY COMPONENT ALTERNATIVES

SITE	PROPOSED COMPONENTS
LF-2N	Landfill only or Landfill and Physical/Chemical Treatment Plant
LF-4N	Landfill only or Landfill and Physical/Chemical Treatment Plant
PI-1N	Physical/Chemical Treatment Plant and/or Incineration Plant
PI-13N	Physical/Chemical Treatment Plant and/or Incineration Plant
LF-3C	A Fully Integrated Facility (i.e. Landfill, Physical/Chemical Treatment Plant and Incineration Plant)
LF-9C	Fully Integrated Facility
LF-1E	Fully Integrated Facility or Landfill only
PI-27E	Physical/Chemical Treatment Plant and/or Incineration Plant

Some of the candidate sites are not projected to have fully integrated facilities. Therefore the candidate sites have been combined in pairs to provide a series of fully integrated siting options. These options are listed below:

LF-2N/PI-1N
LF-4N/PI-1N
LF-1E/PI-27E
LF-2N/PI-13N
LF-4N/PI-13N

1.6 ACCESS ROUTE OPTIONS

A number of access routes to and between the various candidate sites were carried forward from Phase 3B to Phase 4A. Some of these routes were designated as "preferred" and some as "alternative". Additional alternative routes were also identified (Site Selection Process, Phase 4A: Selection of a Preferred Site(s) - Transportation; M.M. Dillon Limited, 1985b). To reduce the number of alternative access routes to each site, the site selection consultants conducted a further analysis of the options during Phase 4A. The Phase 4A analysis by the site selection team was conducted at two levels of detail:

- a preliminary evaluation of options using access road factors employed in Phase 3B, and
- a second (more detailed) level of analysis of access route options, involving a wider range of factors.

The access route analyses by the surface water team included:

- the investigation (during the refinement of siting options) of alternative routes to and between candidate sites, where alternative routes existed, as provided by the transportation consultant (M.M. Dillon Limited) at the end of the preliminary evaluation; and
- the investigation of the preferred access routes during the comparison of siting options.

Alternative access routes were considered in terms of the alternative routes going to the integrated siting options or to the "PI" site and the alternative routes going between the "PI" site and the "LF" site, as appropriate. The following subsections describe the preferred access routes to and between each candidate site at the beginning of the surface water analysis. Where alternative routes were analysed, these routes are identified with option numbers.

1.6.1 SITING OPTION:LF-2N/PI-13N

To PI-13N:

1.* from Hwy 401-south on Fourth Line Road; east on Britannia Road; south on Fifth Line Road to PI-13N

- from QEW - north on Hwy 25 (Bronte Road); east on Britannia Road; south on Fifth Line Road to PI-13N

To LF-2N:

1. from Hwy 401 - north on Hwy 10 to LF-2N, and

2. from Hwy 410 - west on Derry Road to LF-2N.

From PI-13N to LF-2N:

1. north on Fifth Line Road; west on Britannia Road; north on Fourth Line Road; east on Hwy 401; north on Hwy 10 to LF-2N

These routes are shown on Figures 4 and 5.

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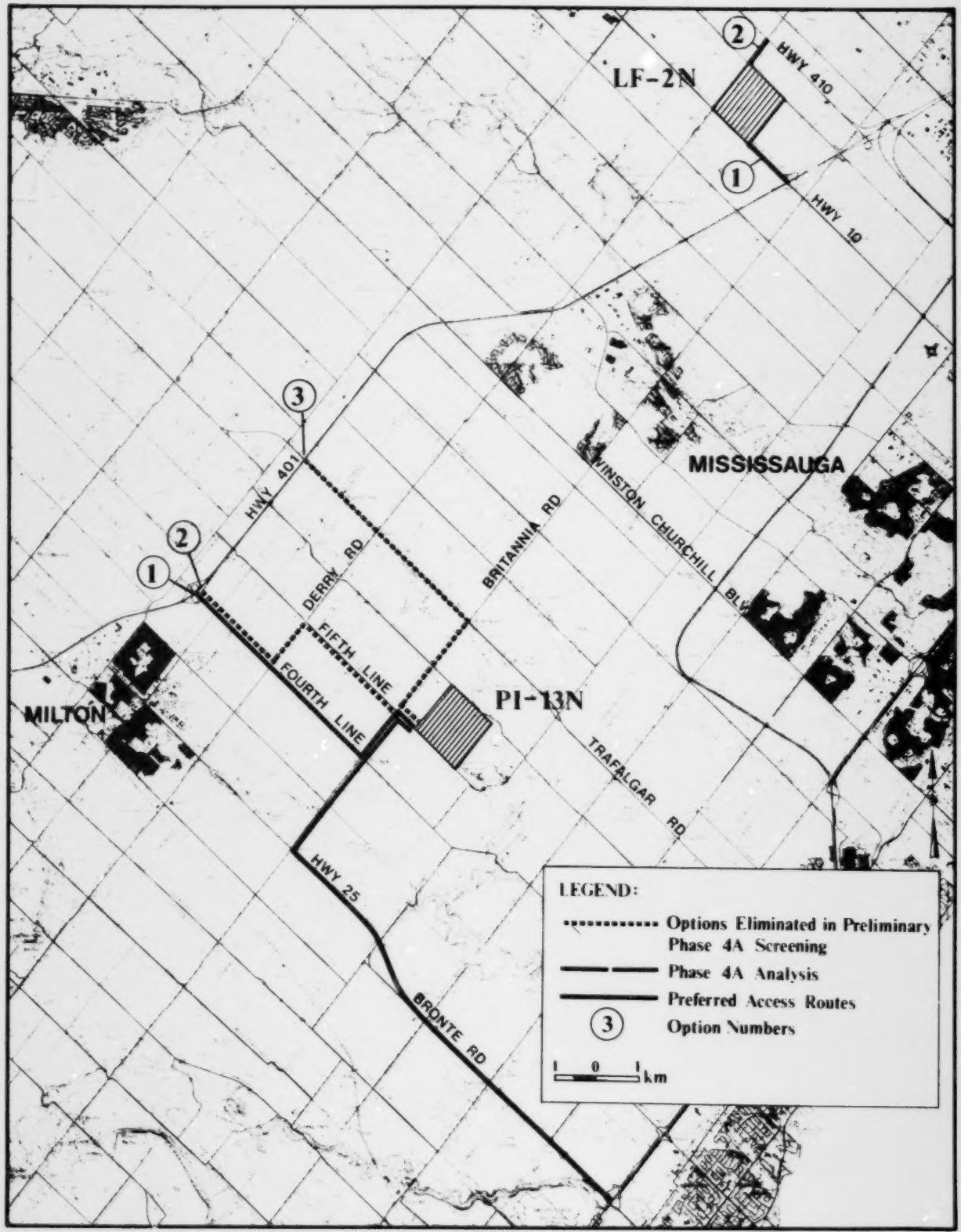
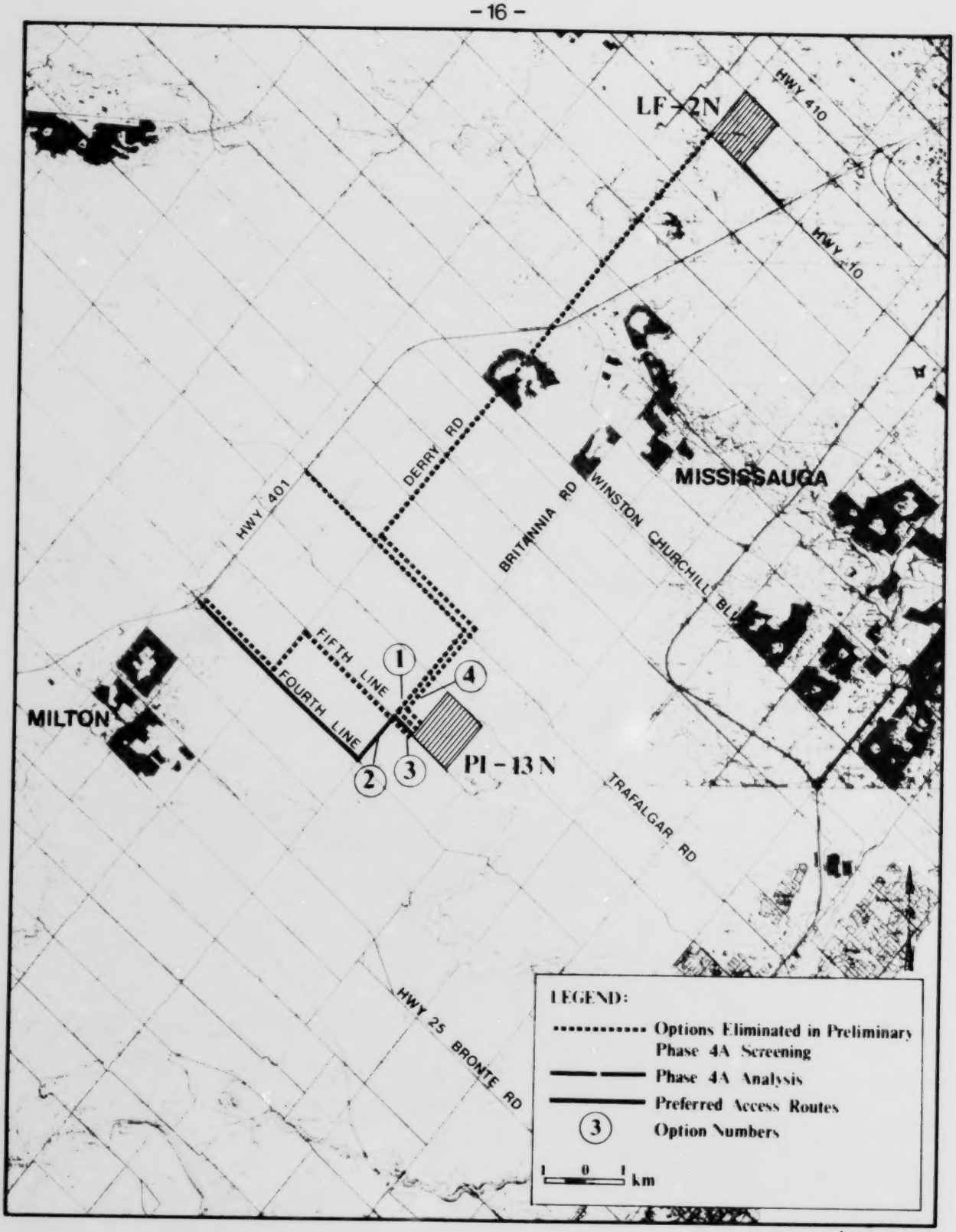
*Access road identification numbers are carried forward from earlier analyses.



LF-2N/PI-13N
TO PI-13N

PHASE 4A ACCESS ROADS

FIGURE 4



LF-2N/ PI-13N
PI-13N TO LF-2N

PHASE 4A ACCESS ROADS

FIGURE 5

1.6.2 SITING OPTION:LF-2N/PI-1N

To PI-1N:

1. from Hwy 401 - south on Fourth Line; west on Britannia Road to PI-1N

- from Q.E.W. - north on Hwy 25 (Bronte Road) to PI-1N.

To LF-2N:

1. from Hwy 401 - north on Hwy 10 to LF-2N, and

2. from Hwy 410 - west on Derry Road to LF-2N.

From PI-1N to LF-2N:

1. east on Britannia Road; north on Fourth Line Road, east on Hwy 401; north on Hwy 10 to LF-2N

These routes are shown on Figures 6 and 7.

1.6.3 SITING OPTION:LF-4N/PI-13N

To PI-13N:

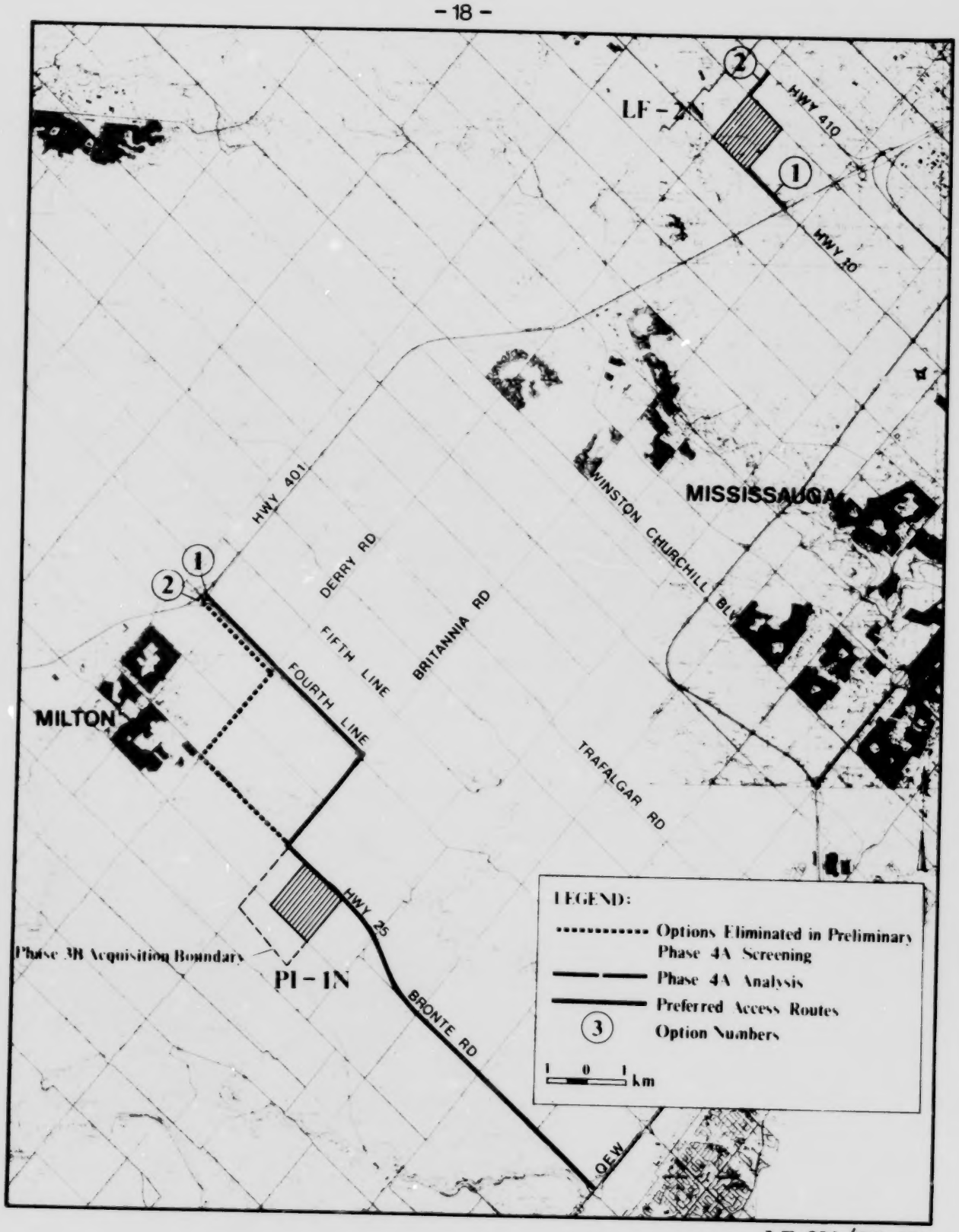
1. from Hwy 401 - south on Fourth Line Road; east on Britannia Road; south on Fifth Line Road to PI-13N.

- from Q.E.W. - north on Hwy 25 (Bronte Road); east on Britannia Road; south on Fifth Line Road to PI-13N.

To LF-4N:

1. from Hwy 401 - south on Fourth Line Road, west on Britannia Road to LF-4N; and

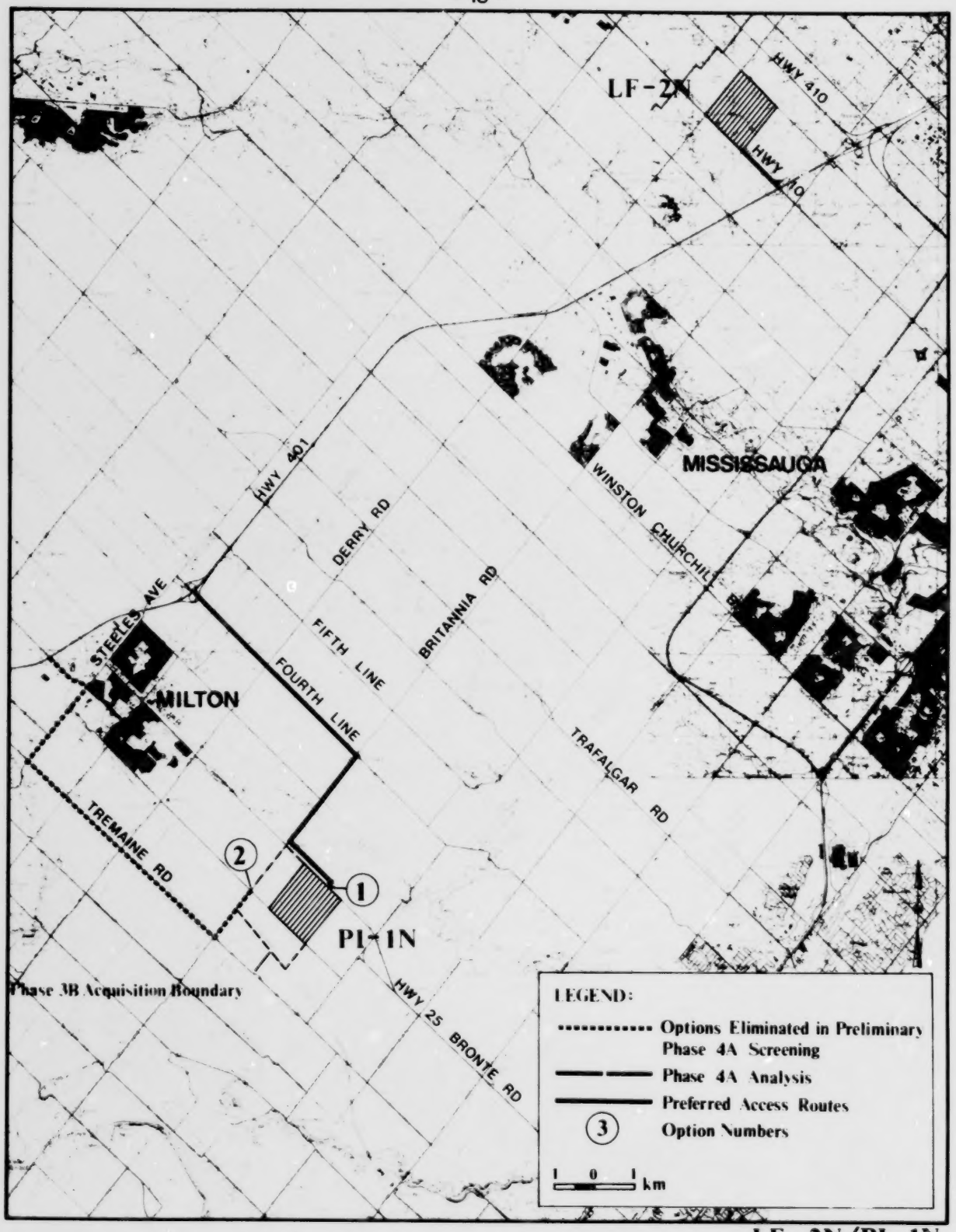
- from the Q.E.W. - north on Hwy 25 and west on Britannia Road to LF-4N.



LF-2N/PI-1N TO PI-1N

PHASE 4A ACCESS ROADS

FIGURE 6



LF-2N/PI-1N
PI-1N TO LF-2N

PHASE 4A ACCESS ROADS

FIGURE 7

From PI-13N to LF-4N:

- north on Fifth Line Road; west on Britannia Road to LF-4N.

These routes are shown on Figures 4, 8 and 9.

1.6.4 SITING OPTION:LF-4N/PI-1N

To PI-1N:

1. from Hwy 401 - south on Fourth Line; west on Britannia Road to PI-1N

- from Q.E.W. - north on Hwy 25 (Bronte Road) to PI-1N.

To LF-4N:

1. from Hwy 401 - south on Fourth Line Road, west on Britannia Road to LF-4N; and

- from the Q.E.W. - north on Hwy 25 and west on Britannia Road to LF-4N.

From PI-1N to LF-4N:

Option 1. north on Hwy 25 (Bronte Road); west on Britannia Road to LF-4N.

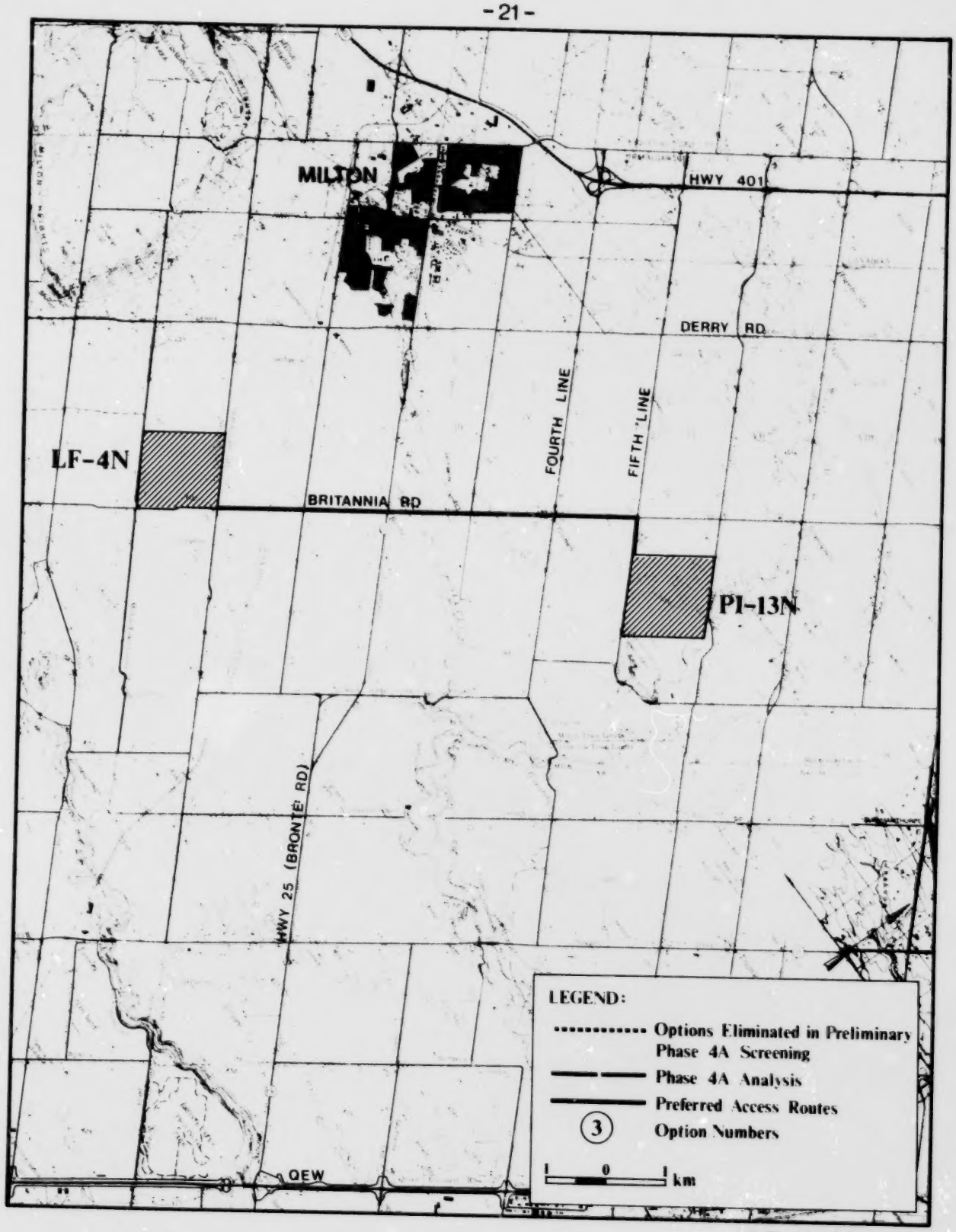
Option 2. north on First Line Road; west on Britannia Road to LF-4N.

These routes are shown on Figures 6, 9 and 10.

1.6.5 SITING OPTION:LF-3C

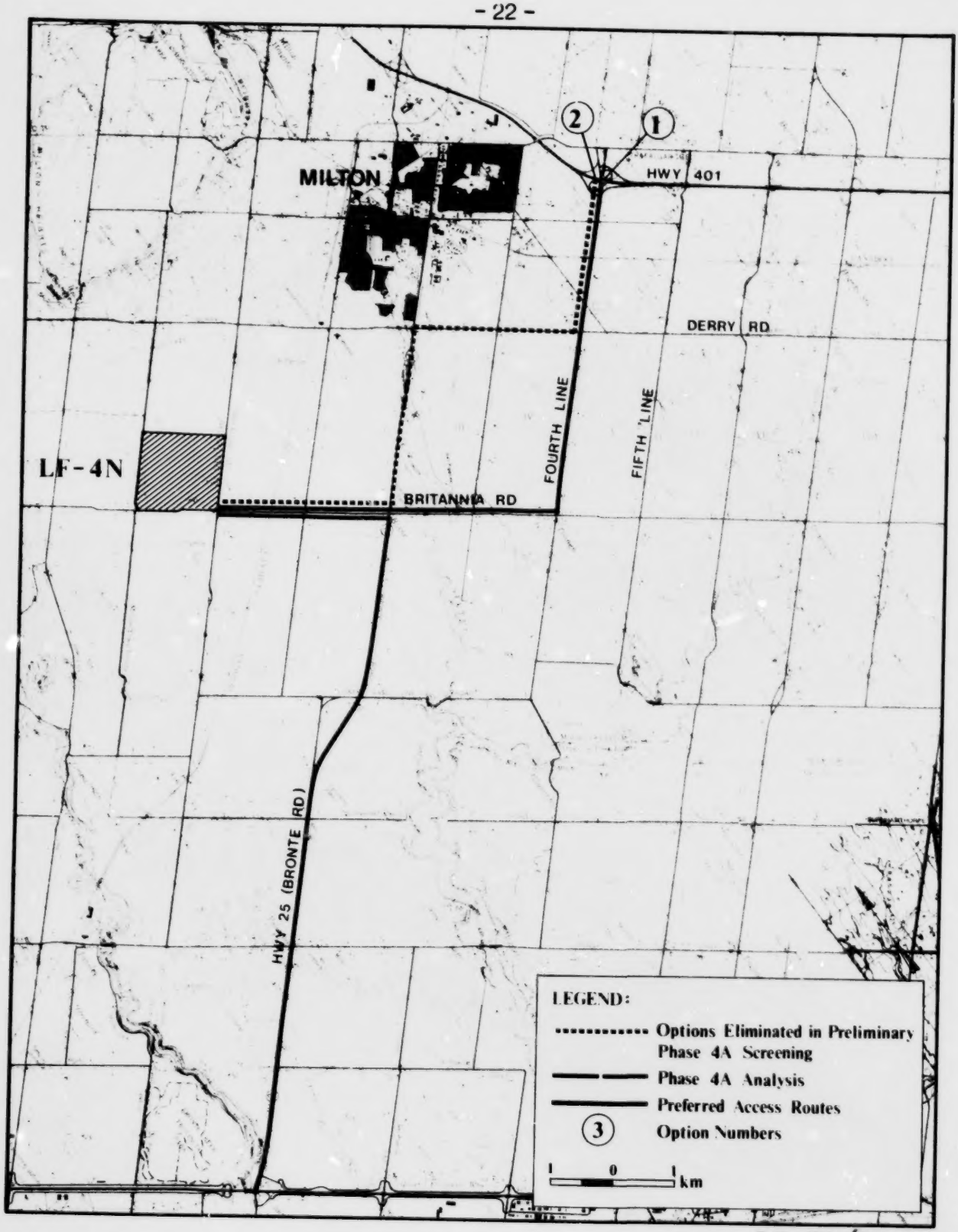
To LF-3C:

Option 1. from Q.E.W. - south on Vineland Townline Road (Regional Road 24); west on Hwy 20; south on Regional Road 27; west on Elcho Road to LF-3C, and



LF-4N/ PI-13N
PI-13N TO LF-4N
PHASE 4A ACCESS ROADS

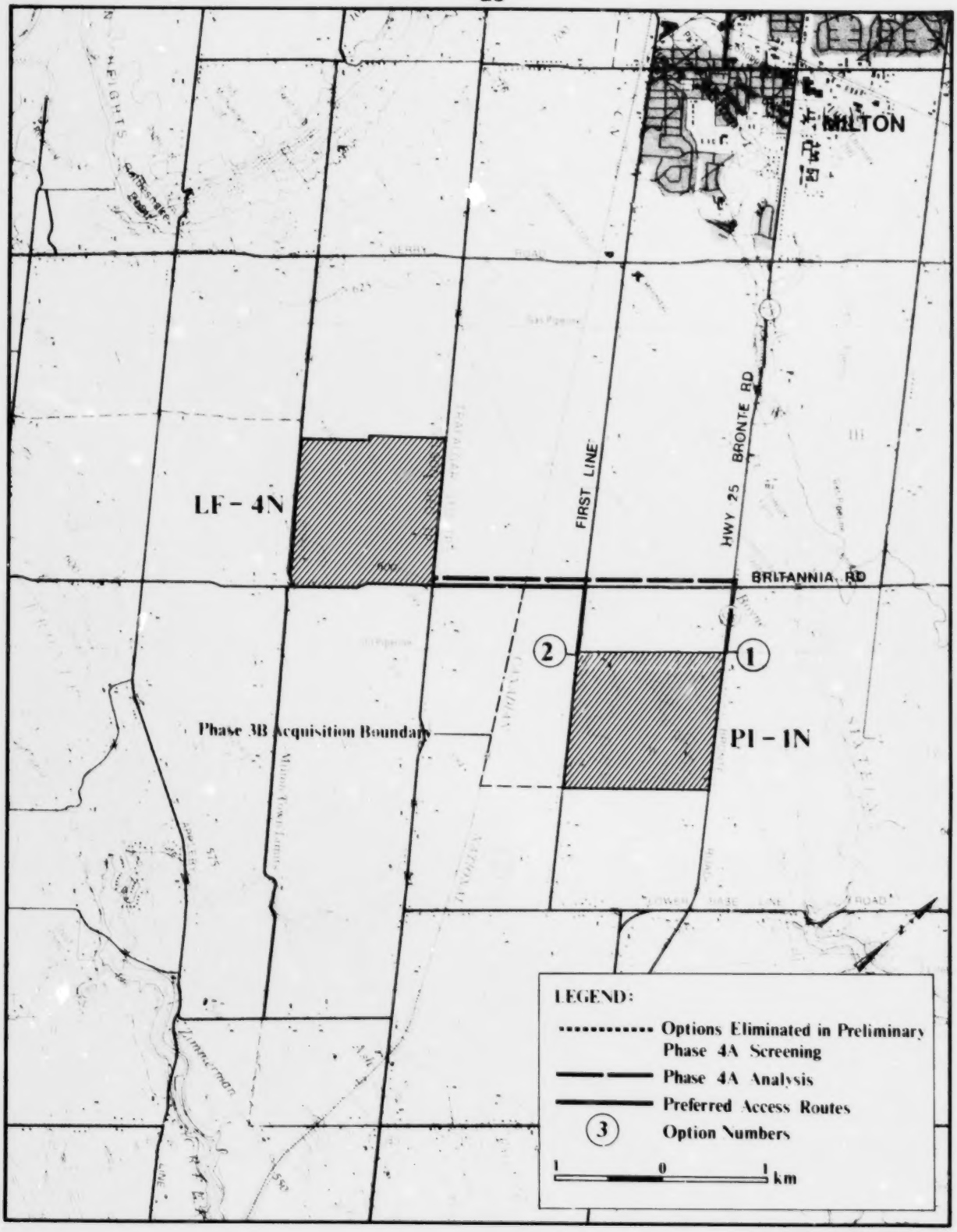
FIGURE 8



LF-4N / PI-1N TO LF-4N

PHASE 4A ACCESS ROADS

FIGURE 9



LF-4N/ PI-1N
PI - 1N TO LF-4N
PHASE 4A ACCESS ROADS

FIGURE 10

Option 6. from Q.E.W. - south on Vineland Townline Road (Regional Road 24); west on Highway 20; west on Regional Road 65 from Bismarck; south on Krick Road to LF-3C.

These routes are shown on Figure 11.

1.6.6 SITING OPTION:LF-9C

To LF-9C:

1. from Q.E.W. - south on Vineland Townline Road (Regional Road 24); west on Hwy 20 to LF-9C.

This route is shown on Figure 12.

1.6.7 SITING OPTION:LF-1E

To LF-1E:

Option 1.* from Q.E.W. - west on Regional Road 47 (Lyons Creek Road/ Biggar Road); south on Regional Road 98 (Montrose Road); west on Carl Road to LF-1E,

Option 3. from Q.E.W. - west on Regional Road 47 (Lyons Creek Road/ Biggar Road); south on Crowland Avenue to LF-1E,

Option 4. from Q.E.W. - west on Regional Road 47 (Lyons Creek Road/ Biggar Road); south on Montrose Road; west on Young Road to LF-1E,

Option 5. from Q.E.W. - west on Regional Road 47 (Lyons Creek Road/ Biggar Road); south on Montrose Road; west on Schisler Road (Regional Road 27) to LF-1E,

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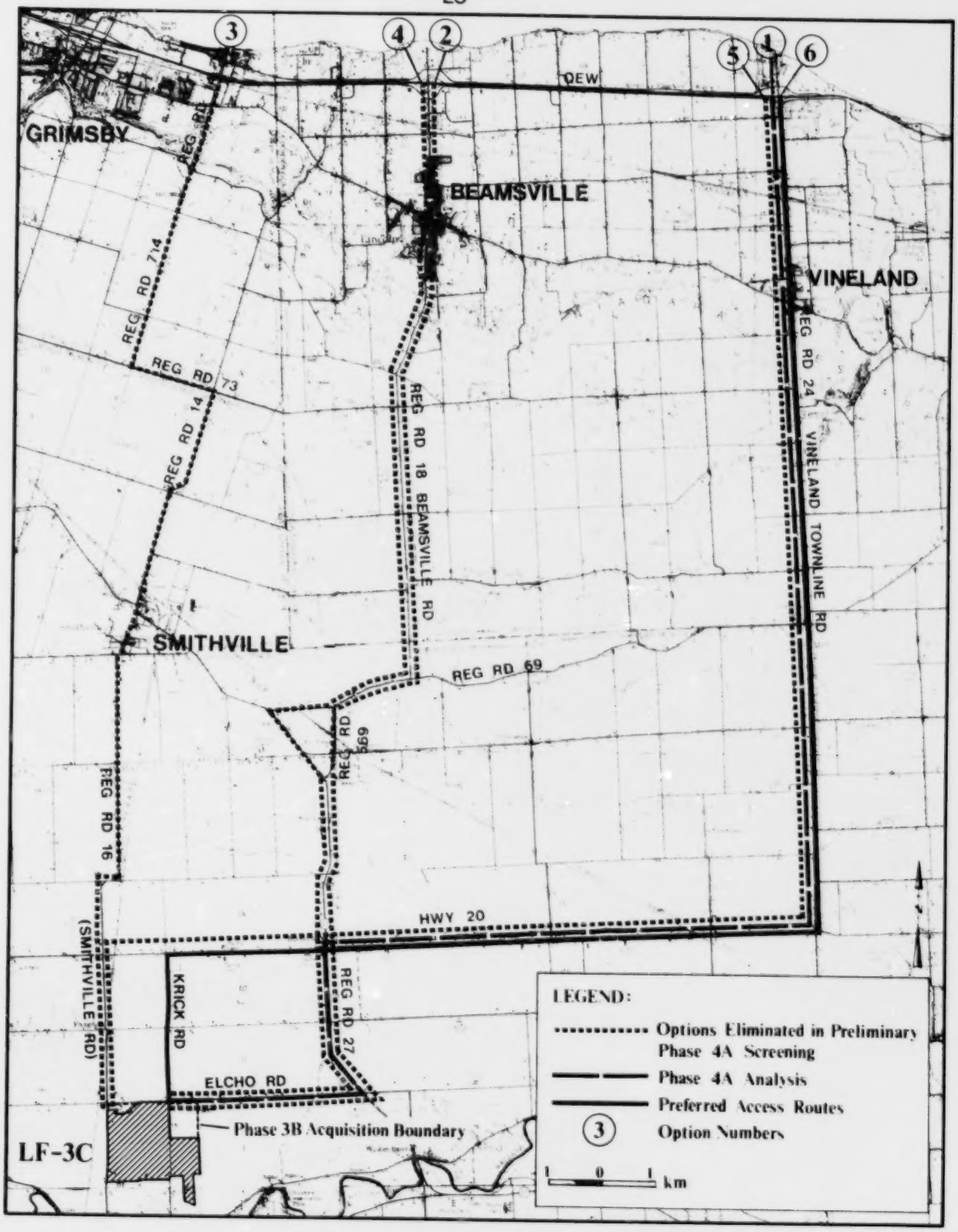
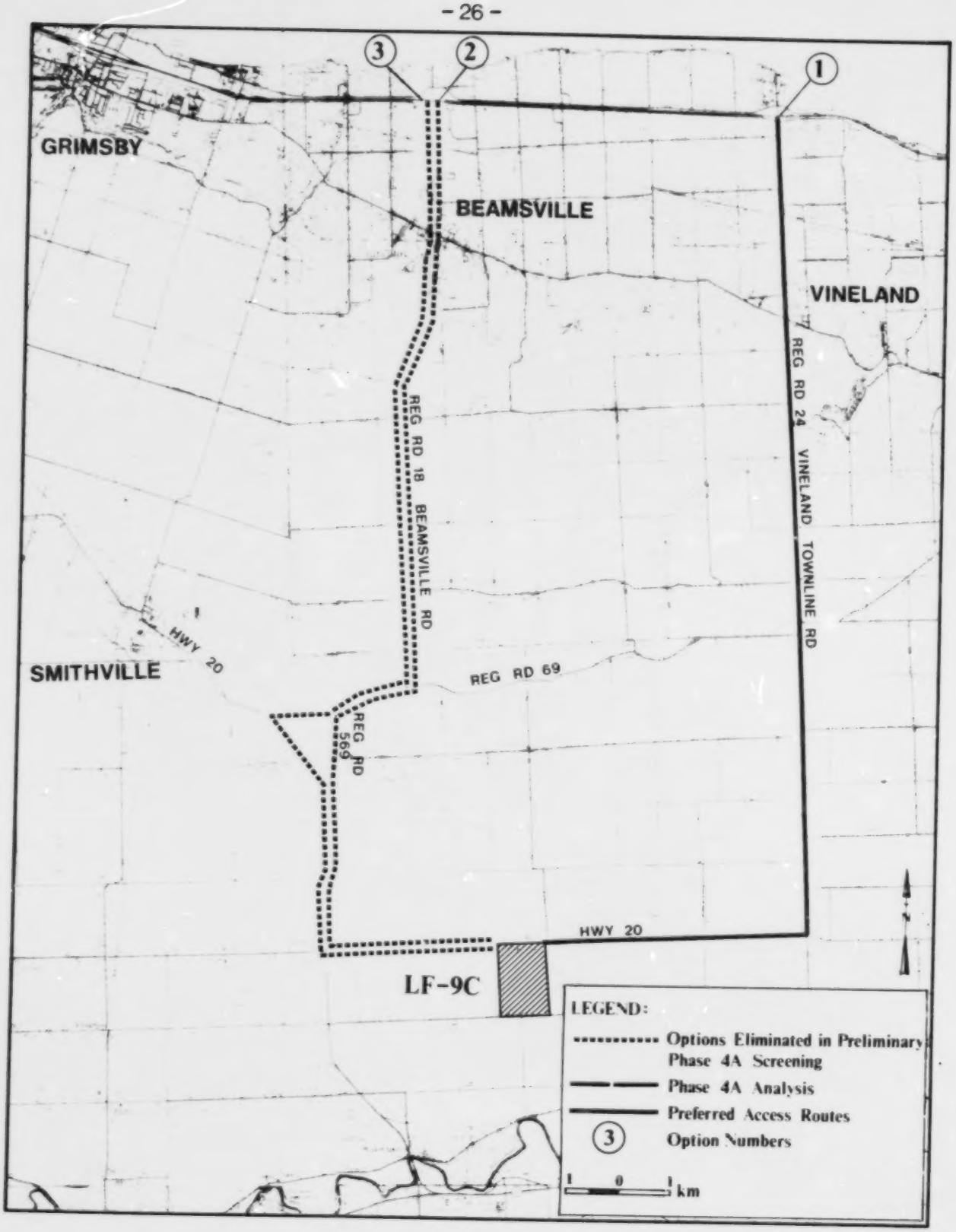
* Option 2 was removed from consideration during the Phase 4A preliminary analysis step.



LF-3C

PHASE 4A ACCESS ROADS

FIGURE 11



LF-9C

PHASE 4A ACCESS ROADS

FIGURE 12

Option 6. from Q.E.W. - west on Regional Road 47 (Lyons Creek Road/ Biggar Road); south on Crowland Avenue; west on Carl Road to LF-1E, and

Option 7. from Q.E.W. - west on Regional Road 47 (Lyons Creek Road/ Biggar Road); south on Montrose Road; west on Carl Road; south on Crowland Avenue to LF-1E.

These routes are shown on Figure 13.

1.6.8 SITING OPTION:LF-1E/PI-27E

To PI-27E:

Option 1. from Q.E.W. - west on Regional Road 47 (Lyons Creek Road/ Biggar Road) to PI-27E, and

Option 2. from Q.E.W. - west on Regional Road 47; north on Regional Road 98 to PI-27E.

From PI-27E to LF-1E:

Option 1.* from PI-27E - east on Bigger Road; south on Regional Road 98 (Montrose Road); west on Carl Road to LF-1E,

Option 3. from PI-27E - west on Biggar Road; south on Crowland Avenue to LF-1E,

Option 4. from PI-27E - east on Biggar Road; south on Montrose Road; west on Young Road to LF-1E,

Option 5. from PI-27E - east on Biggar Road; south on Montrose Road; west on Schisler Road to LF-1E,

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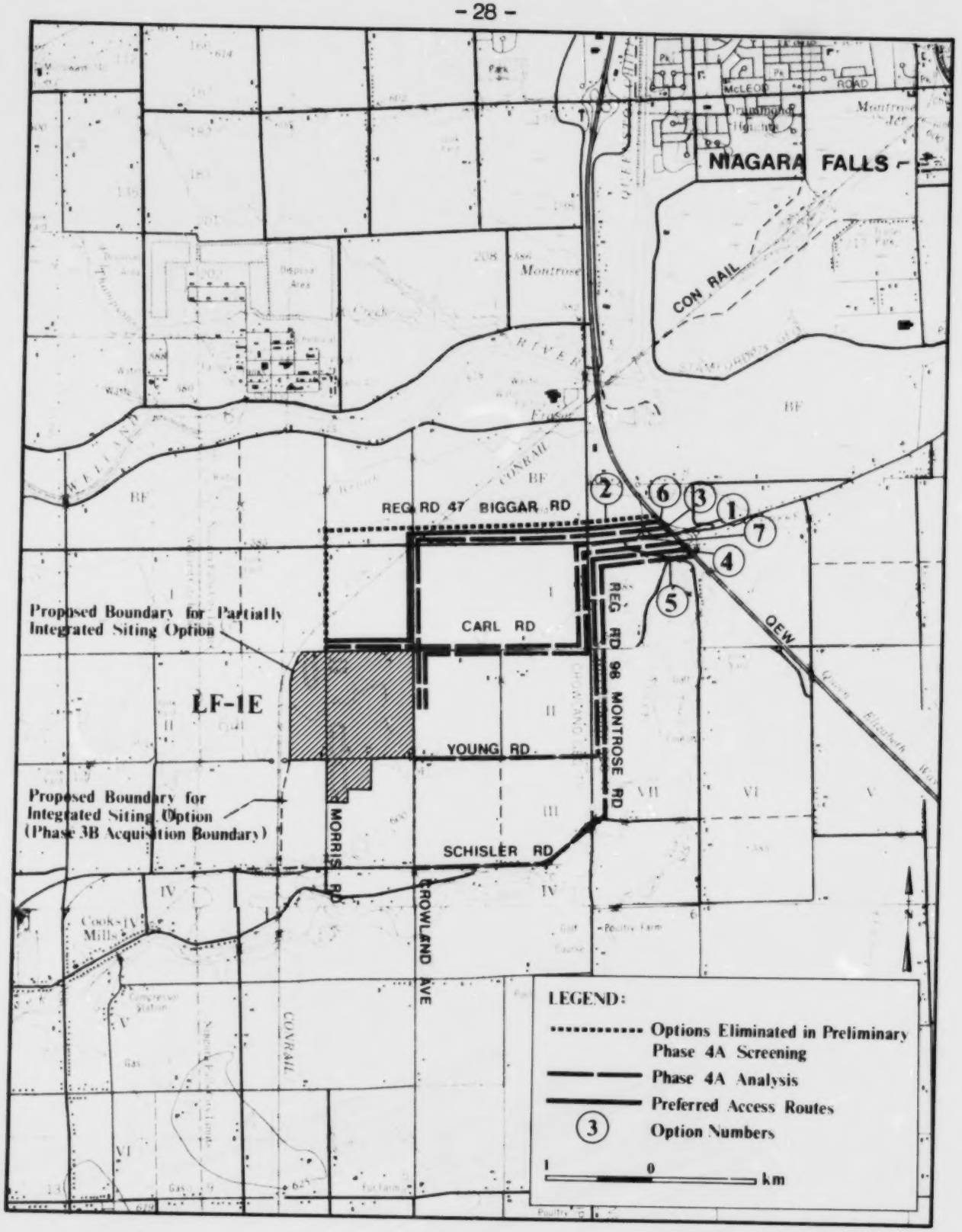
* Option 2 was removed from consideration during the Phase 4A preliminary analysis step.



LF-1E

PHASE 4A ACCESS ROADS

FIGURE 13

Option 6. from PI-27E - west on Biggar Road; south on Crowland Avenue, west on Carl Road to LF-1E,

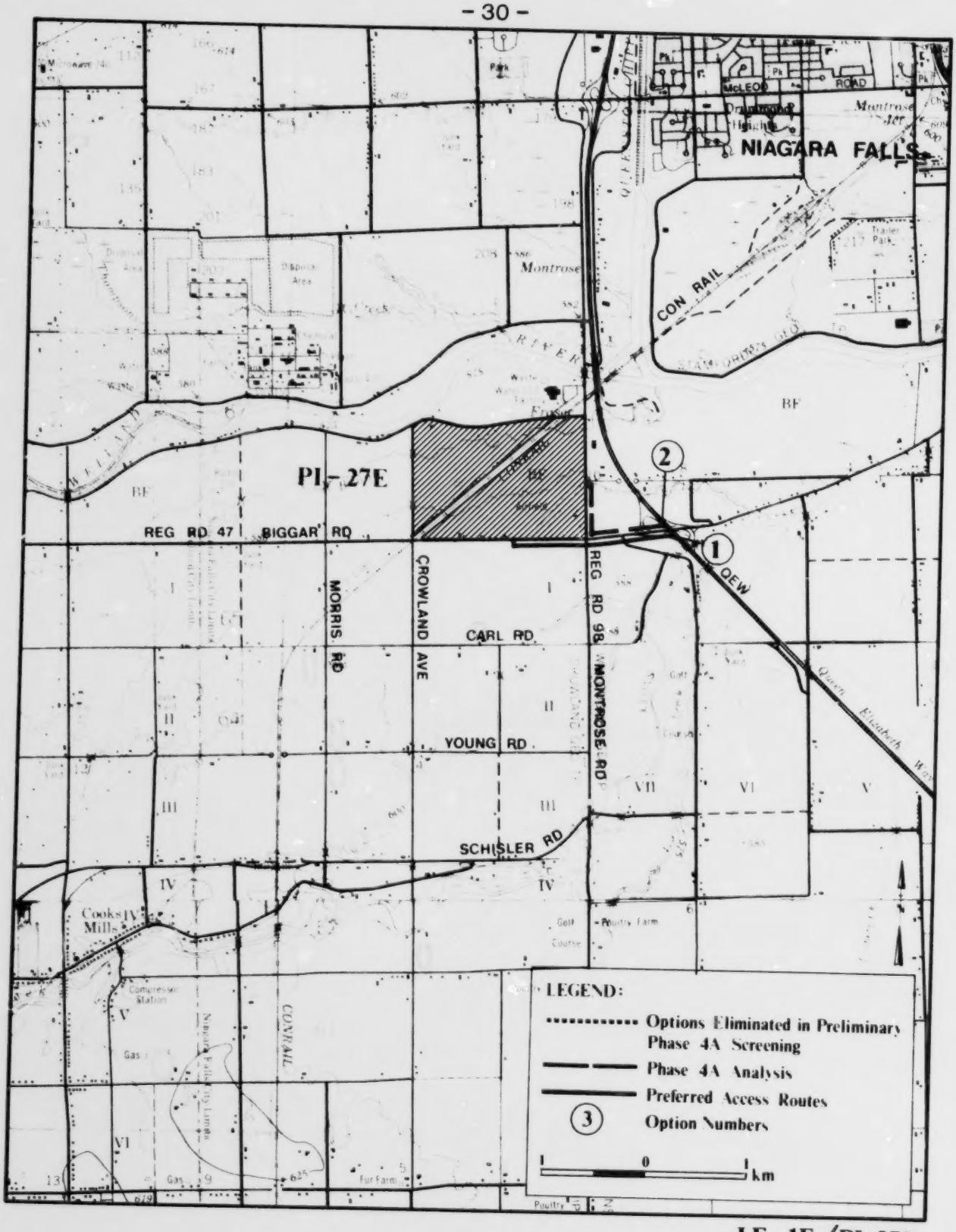
Option 7. from PI-27E - east on Biggar Road; south on Montrose Road; west on Carl Road; south on Crowland Avenue to LF-1E.

These routes are shown on Figures 14 and 15.

1.7 RAIL ACCESS OPTIONS

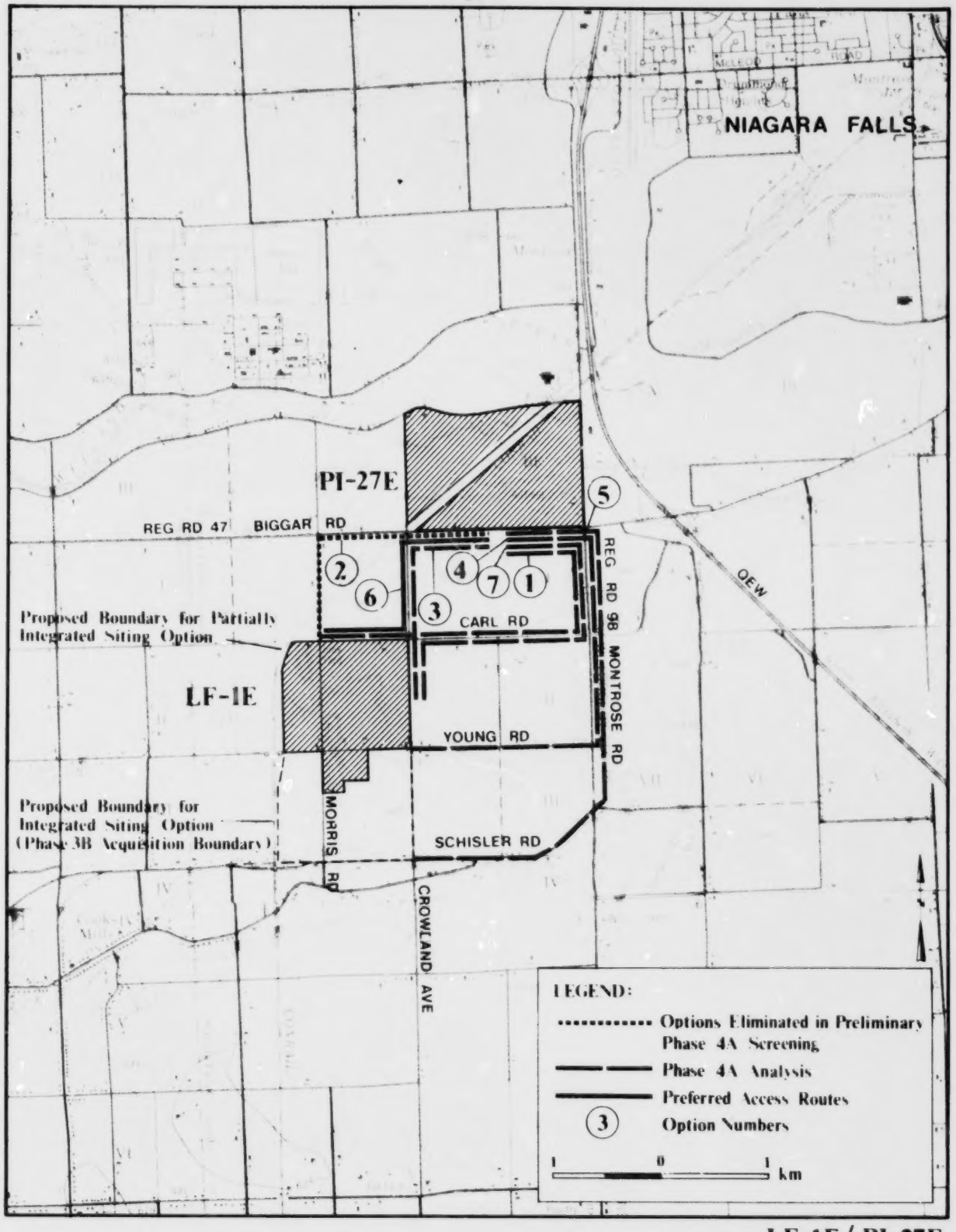
Rail service is viewed as an opportunity for the bulk haulage of process additives and reagents rather than as an absolute requirement of a siting option.

Rail access options were identified by the site selection team through a constraint mapping exercise. Options are shown in Figures 16 through 20.



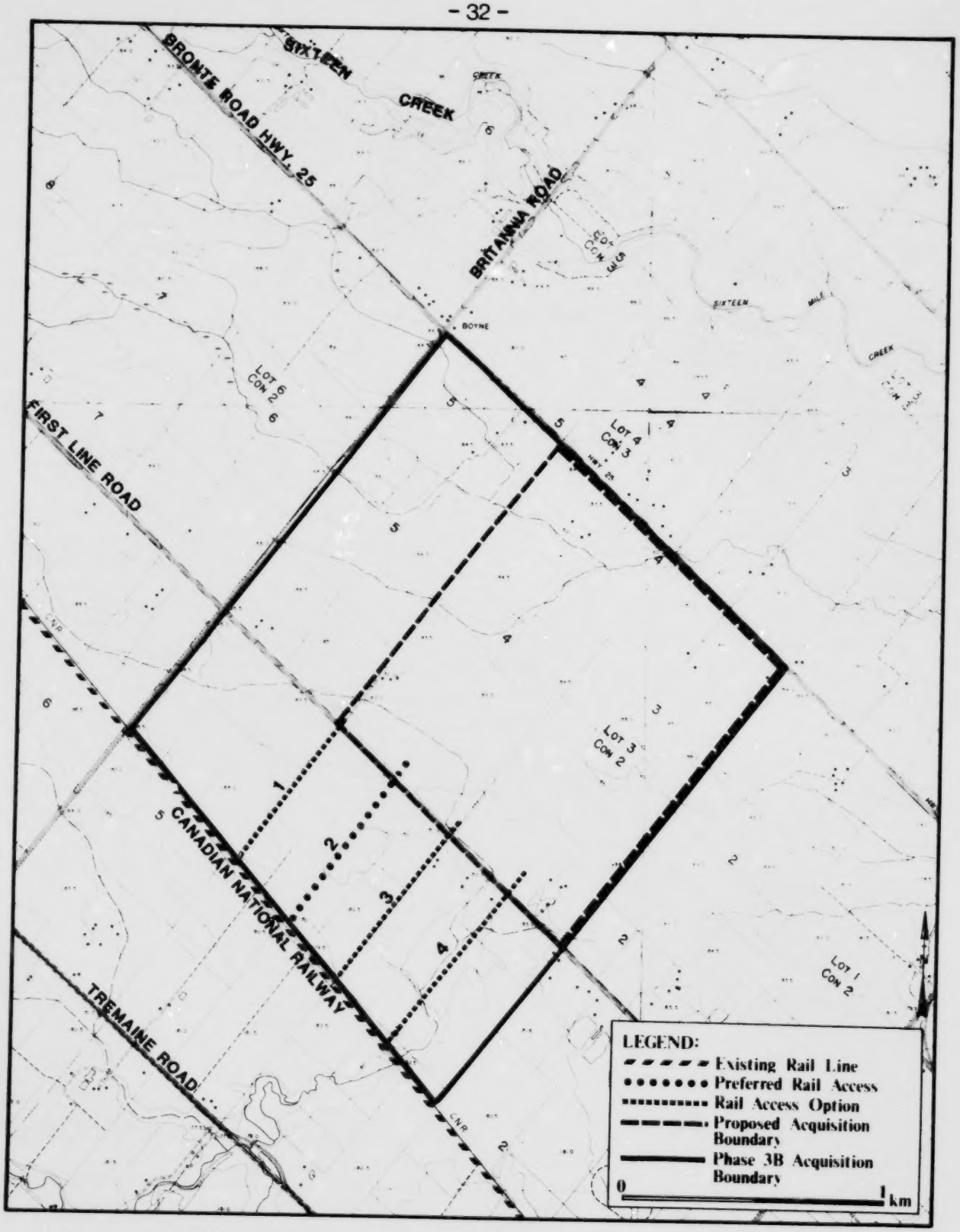
LF-1E /PI-27E
TO PI-27E
PHASE 4A ACCESS ROADS

FIGURE 14



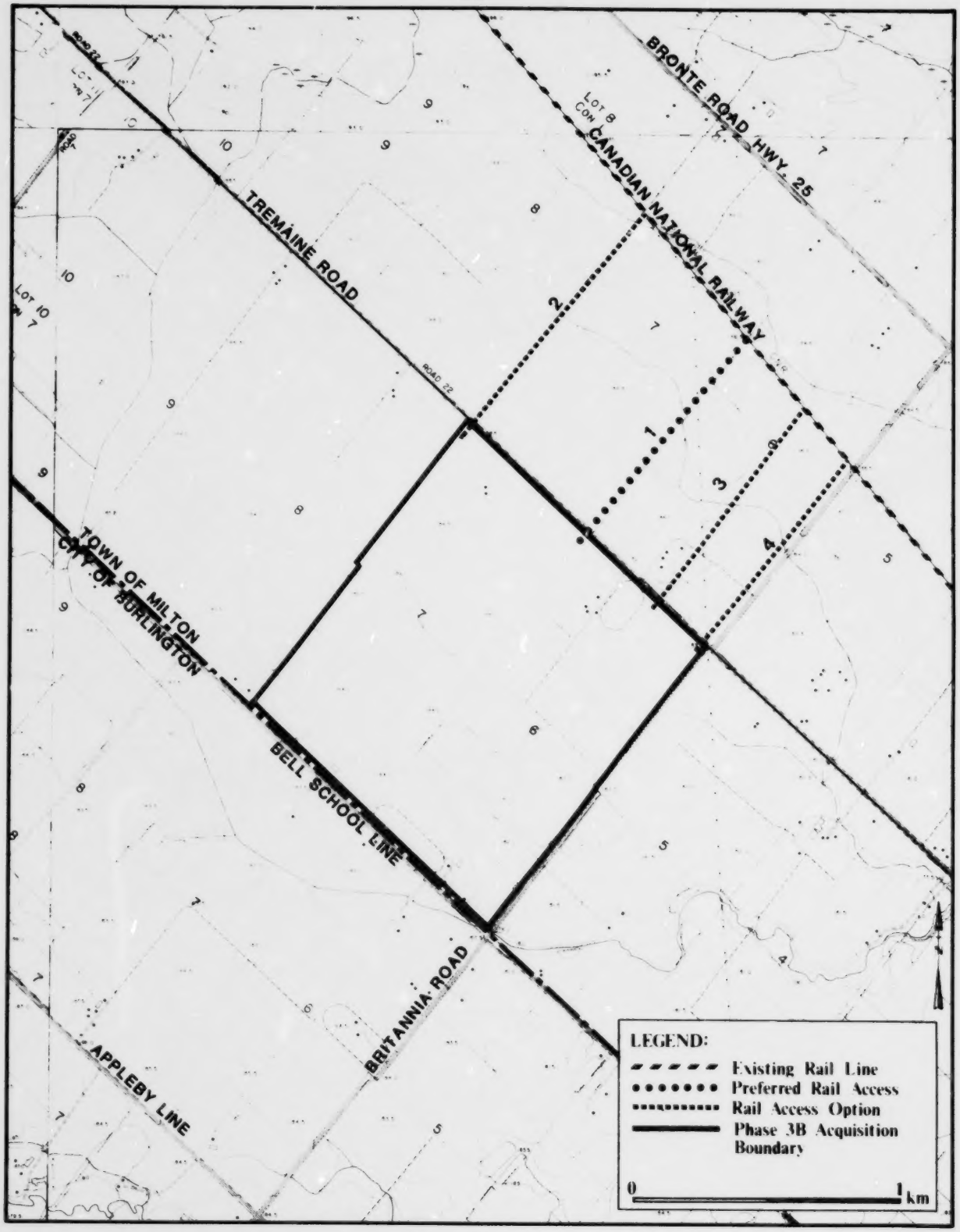
LF-1E/ PI-27E
PI-27E TO LF-1E
PHASE 4A ACCESS ROADS

FIGURE 15

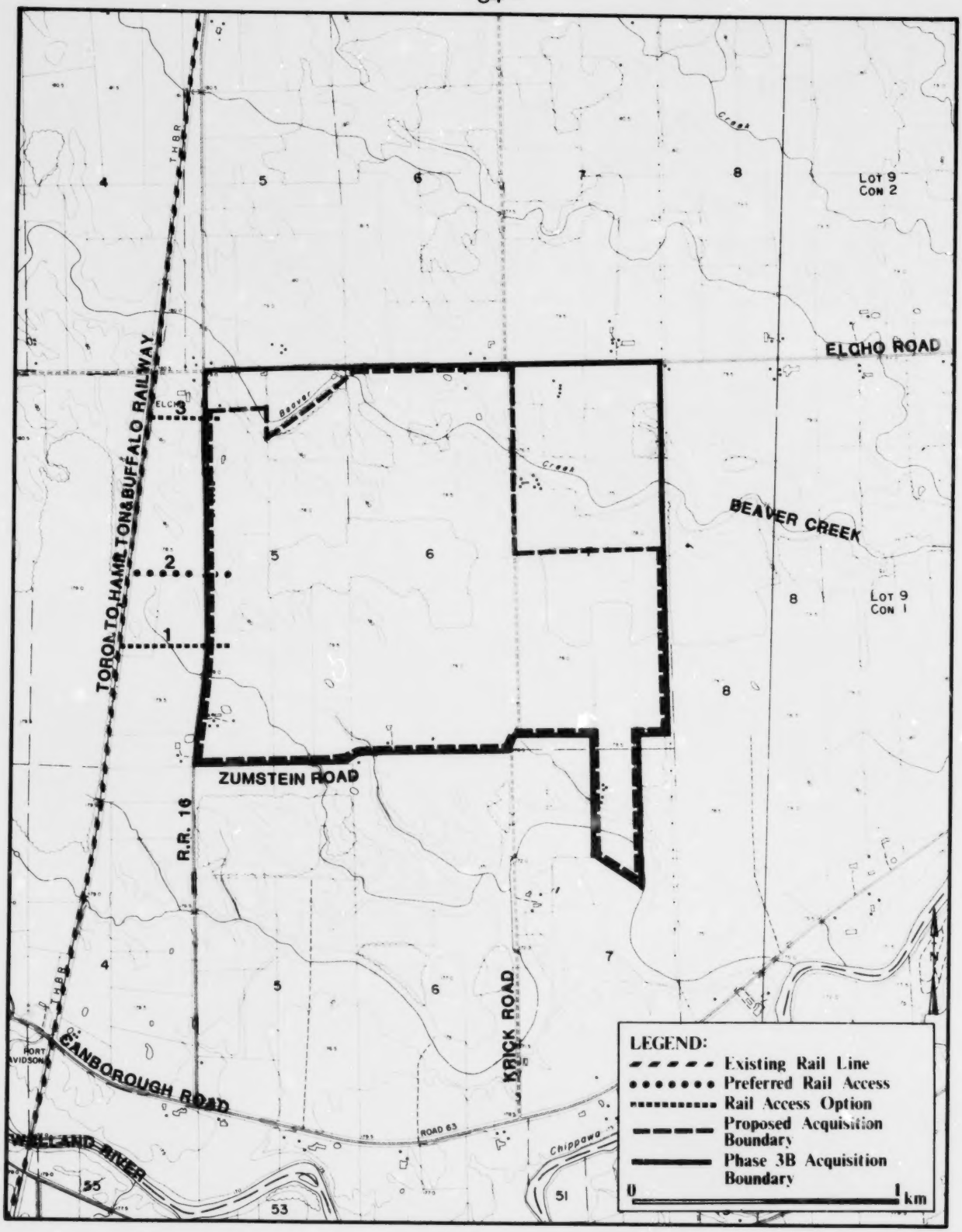


PI-1N
RAIL ACCESS

FIGURE 16

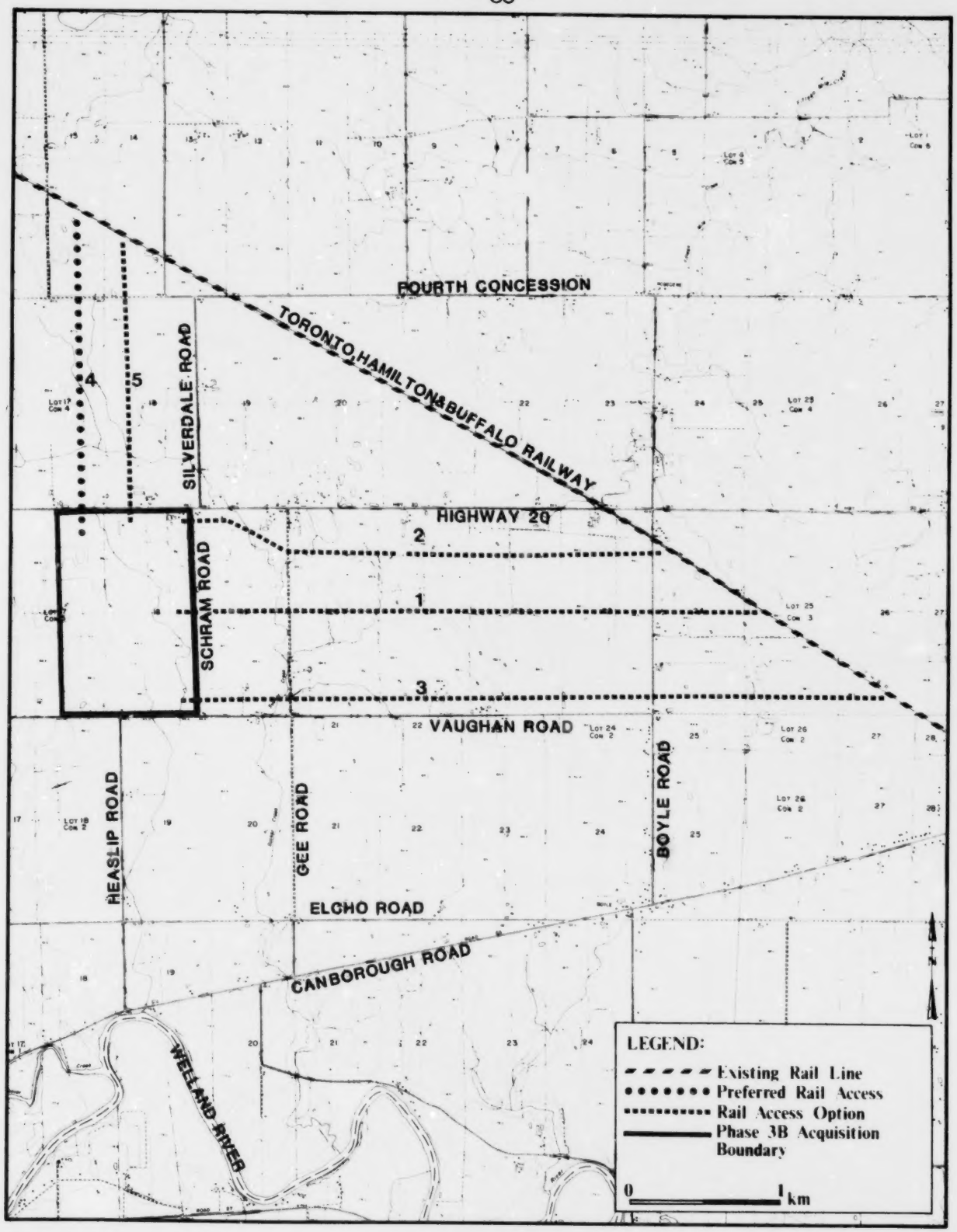


LF - 4N
RAIL ACCESS
FIGURE 17



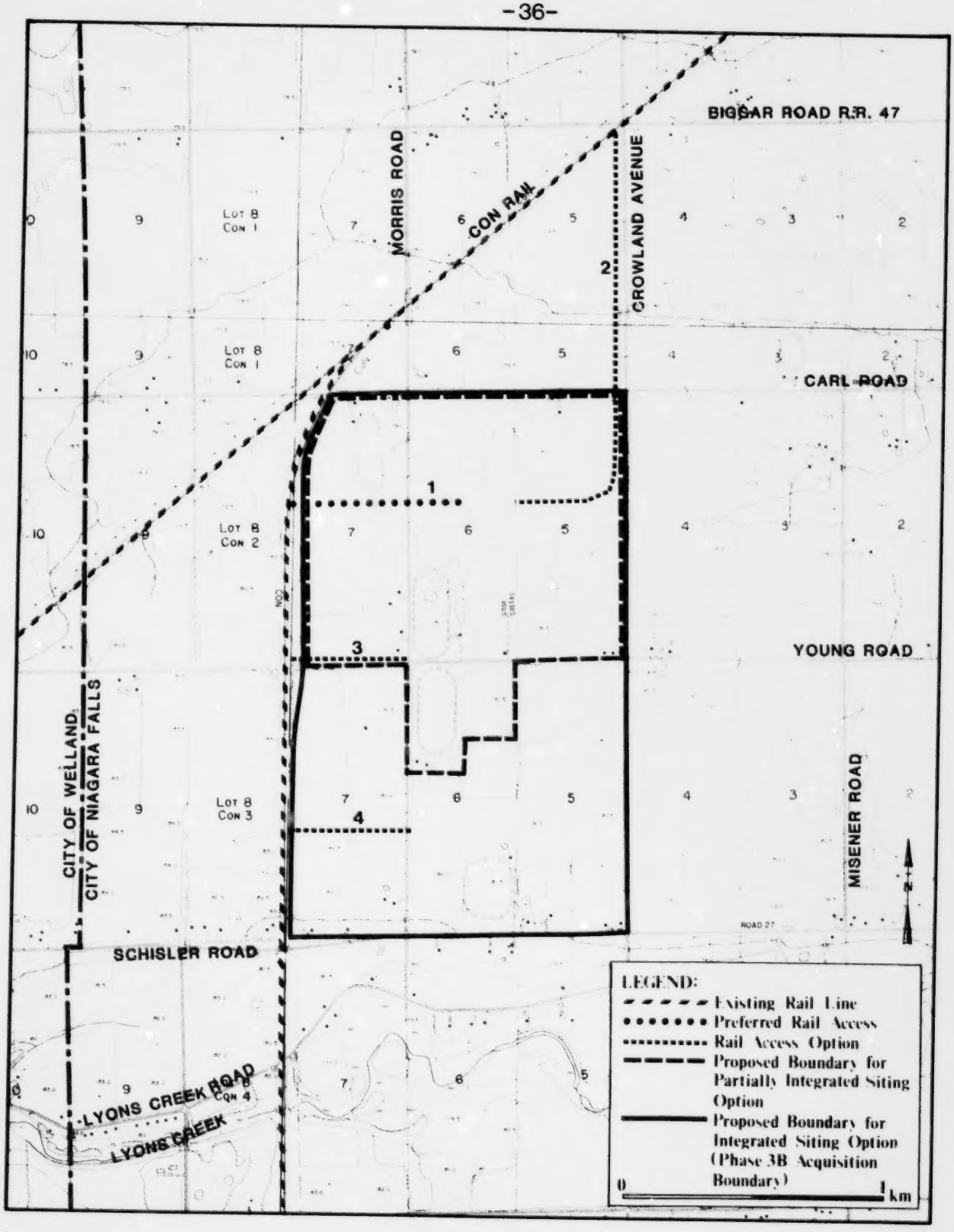
LF-3C
RAIL ACCESS

FIGURE 18



LF-9C
RAIL ACCESS

FIGURE 19



LF-1E
RAIL ACCESS
FIGURE 20

2.0 METHODS

2.1 FACILITY CHARACTERISTICS AND ASSUMPTIONS

The Phase 4A analysis for the refinement of siting options and the comparative evaluation of siting options was based on several facility characteristics provided by Monenco (Status Report, Facility Design; Monenco, 1985a). The facility characteristics that pertain to surface water analysis, are outlined below. A summary of the facility characteristics is contained in Site Selection Process, Phase 4A: Selection of a Preferred Site(s) - Site Selection (M.M. Dillon Limited, 1985c).

1. Water from building roof drains and grassed areas within the central operating area will be collected in a lined storm water pond and will be discharged off-site to a suitable local watercourse, following verification of acceptable quality.

2. Potentially contaminated water from roads will be directed to a separate holding pond and also released to a local watercourse following verification of acceptable quality. If the water is found to be of unacceptable quality for release then it will be sent to the physical/chemical treatment plant for treatment.

3. Water and spills from storage areas and other areas classified as contaminated will be contained and pumped to storage tanks for treatment.

4. Uncontaminated surface drainage from within the undeveloped areas of the engineered landfill will be controlled and discharged off-site to a suitable local watercourse.

5. Surface drainage from the active working areas of the landfill will be treated as potentially contaminated. This water will be directed to holding ponds, tested, and if contaminated, sent to the central operating area for treatment. If it is not contaminated, then it will be discharged off-site to a suitable local watercourse.

6. Surface drainage from completed landfill areas is expected to be uncontaminated. If this is confirmed by analysis in the early stages of landfill development, it will be discharged to a suitable local watercourse.

7. Treated waste water will not be discharged to local surface watercourses, i.e. total solidification or evaporation.

The data requirements and data analysis methods used in the Phase 4A surface water studies were based on a number of assumptions. In cases of data uncertainty (e.g. waste toxicity) worst case situations were assumed. The assumptions used in the Phase 4A surface water analysis are presented as follows:

1. Some hazardous wastes being transported are concentrated, toxic, and if spilled, will flow readily.

2. Spills occurring within the area known as "stream crossing distance" at an access road crossing will

enter a stream and travel downstream to an ultimate receiver (e.g. Lake Erie or Lake Ontario).

3. Contaminants entering streams are toxic and may affect human health and fisheries.

4. Streamflow will be insufficient to dilute spilled wastes to a safe level until the wastes reach the ultimate receiver.

5. Emergency teams will respond promptly to spills to contain and clean up contaminants.

6. For the purposes of this study, rural, wooded and recreational land uses are representative of "sensitive" water use (i.e. could afford a pathway to humans).

7. The access road analysis was confined to the regional and local road systems (i.e. not 400 series highways).

2.2 STUDY AREAS

Five distinct study areas were identified for the Phase 4A surface water studies. These study areas were:

- site;
- site vicinity;
- regional;
- access routes; and
- rail.

These study areas were identified separately because of different analyses that were undertaken in each area.

The "site" study area consisted of the land within the Phase 3B Acquisition Boundaries described in Section 1.4. Flood susceptibility and drainage improvement investigations were undertaken for this study area. Local water uses on the site were also identified although it was recognized that these uses would be displaced by site development.

The "site vicinity" study area consisted of the area between the site acquisition boundary and a line approximately 2 km from the site centre. The site vicinity boundary was irregular and followed property ownership lines. Investigations in the site vicinity study area consisted of runoff potential (from upstream areas draining onto the site), drainage improvement considerations and water use (in areas downstream from the site).

The "regional" study area consisted of watercourses downstream from the site or an access road crossing, to an ultimate receiver. Lake Ontario and the Chippawa/Queenston Power Canal were considered to be ultimate receivers owing to their capability to dilute possible effects of waste contamination from OWMC's facilities or access routes to them.

The "access routes" study area consisted of the access routes themselves as opposed to downstream water courses. Stream crossing distances and critical overland flow distances were measured along the access roads to provide a measure of the likelihood of spilled wastes entering a stream.

The "rail" study area consisted of broad corridors of land, identified by the transportation consultant, M.M. Dillon Limited. A constraint mapping program was undertaken within these areas,

based on the presence of floodplains and wetlands, and the number of stream crossings. A number of rail access options were identified through the constraint mapping exercise. These options were then evaluated in greater detail.

2.3 DATA COLLECTION

Four distinct approaches were used to collect data for the Phase 4A surface water studies. These were:

- a review of data and material prepared during previous OWMC phases;
- meetings and discussions with municipal and provincial agencies;
- meetings, discussions and site tours with local residents; and
- roadside visits to make observations and measurements.

Data collection activities for surface water focused on three main areas of study - flooding, drainage and surface water use.

2.3.1 AGENCY CONTACT

A preliminary review of Phase 4A study objectives and data from previous OWMC work was undertaken to determine data requirements and potential data sources. Federal, provincial and municipal agencies were identified as valuable sources of surface water information. A list of agency contacts and information requests is contained in Appendix A.

Meetings with agencies were arranged in co-operation with OWMC. The bulk of the meetings took place during May, June and July, 1984. Summaries of the meetings were prepared and distributed to those in attendance and to OWMC staff. Copies of the meeting summaries are on file with OWMC. In most cases, agency contact resulted in a great deal of information being made available. This included reports, raw data, maps, discussion and guidance.

2.3.2 PUBLIC CONTACT

The public contact data collection process consisted of the following tasks:

- the distribution of a questionnaire concerning surface water features (walk-and-talk program);
- meetings and discussions with site and site vicinity residents to present preliminary findings and to receive local input on water use, flooding and drainage;
- site tours with local residents to view significant surface water features; and
- follow-up meetings with site groups to present preliminary findings prior to map finalization, to discuss issues and to obtain feedback on findings.

These data collection tasks are discussed in greater detail in the following subsections.

WALK-AND-TALK-QUESTIONNAIRE

The purpose of the walk-and-talk questionnaire was to obtain detailed information from site and site vicinity residents concerning flooding, drainage and water use on the site and immediately downstream from the site. The knowledge and experience of residents familiar with the sites and surrounding areas was recognized as a valuable information source.

In the questionnaire, residents were asked to complete questions relating to several disciplines in addition to surface water. An example of the surface water component of the questionnaire is contained in Appendix B.

Questionnaires were completed during interviews conducted with area residents and property owners. These interviews were conducted by Institute of Environmental Research (IER) and Ecologistics Limited during June, July and August, 1984. The relevant portions of completed questionnaires were forwarded to GLAL for analysis. A summary of the information obtained through this process is contained in Sections 3 through 10 of this volume.

INITIAL MEETING WITH SITE GROUPS

Gartner Lee Associates Limited participated in meetings with most of the site groups. The purpose of these meetings was to introduce GLAL staff to concerned area residents, and to present the surface water study approach and initial results obtained through agency contact and completed questionnaires. Meeting participants often were able to verify, correct, and/or supply additional information to GLAL's preliminary maps. These initial site meetings took place between July and November, 1984. A listing of meetings is contained in Appendix C.

SITE INSPECTIONS WITH LOCAL RESIDENTS

Local residents who were very familiar with the surface water features of the area were often identified as a result of the initial series of meetings between GLAL and site groups. Many of these individuals assisted the surface water study team in identifying local surface water uses, flooding history and drainage characteristics. This valuable information was provided during meetings at residents' homes and/or during guided tours of the site and site vicinity. A list of these meeting/tours is contained in Appendix C.

FOLLOW-UP MEETINGS WITH SITE GROUPS

Prior to report finalization additional meetings were held with the site groups to discuss surface water issues and to review our use and interpretation of data provided.

2.3.3 FIELD STUDIES

Roadside inspections were held at each candidate site to aid in the assessment of the relative flood susceptibility and potential drainage improvements which may be required. Observations, photographs and measurements taken during these visits were used to verify and supplement data obtained from topographic mapping and aerial photography and from previous phases of this study.

Specifically, the site inspections were used to:

- identify and measure opening areas of all culverts which convey runoff onto, through and away from the site, together with the approximate vertical distance from each culvert to the top of road;

- observe and photograph swales and channels on, and downstream from the sites;
- verify, where possible, drainage boundaries (catchment boundaries) which were estimated from topographic mapping or aerial photograph interpretation;
- obtain a general impression of the relative ease or difficulty of draining each of the candidate sites;
- to observe existing conditions of flooding on and in the vicinities of the sites (February, 1985); and
- to observe local surface water use.

During the site visits, all measurements and observations were taken from public roadway allowances and not from private property.

2.4 DATA ANALYSIS

2.4.1 FLOOD SUSCEPTIBILITY

The data collected from topographic mapping, aerial photography and during site visits were used in the assessment of the flood susceptibility of each of the sites. Data have been applied to the three major indicators of the flood susceptibility factor*:

- designated floodplain lands and flood-prone areas;
- runoff potential; and
- conveyance capacity.

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*For a discussion of factors and indicators see Appendix A of the main part of this report (Site Selection Process, Phase 4A: Selection of a Preferred Site(s) - Surface Water; GLAL, 1985a).

Designated floodplains are those lands identified by the Conservation Authorities as the Regional Storm Floodplain, i.e. inundated under the "Regional Flood". The Regional Flood is the flood caused by a designated Regional Storm or a storm with a return period of 100 years and an event length matched to catchment characteristics, whichever is greater. The appropriate Conservation Authorities were contacted, and all designated floodplains on, or in the vicinity of the sites were identified and mapped on a series of surface drainage maps in Sections 3 to 10 of this volume. The absence of floodplains on or adjacent to a particular site indicates that either the Regional Storm Floodplain does not encroach on the site or that no floodplain mapping studies have been undertaken by the Conservation Authority in the immediate vicinity of the site.

Flood-prone areas have also been shown on the above mentioned figures. A "flood-prone" designation refers to areas of poor surface drainage where periodic flooding may occur. These areas were identified by stereoscopic interpretation of aerial photographs.

Runoff potential is an indicator of the volume and peak flow rate of storm water which must be accommodated by culverts, swales and channels draining the candidate sites. Runoff currently conveyed through a candidate site may be generated on-site or it may include runoff from upstream areas. Peak flow rates were estimated for existing conditions, using the Rational Method (Handbook of Applied Hydrology; Chow, 1964). This is a simple and effective means of assessing the relative runoff potential from or upstream of each of the candidate sites. Watershed size, shape, slope and soil type, together with local rainfall data are the main data requirements for the assessment of runoff potential. Storms with a variety of

return periods were considered (5, 10, 50 and 100 years). The length of the storm was matched to the time of concentration of the watershed upstream from the site or culvert of concern.

Conveyance capacity refers to the flow rate which can be conveyed by a bridge, culvert or swale without flooding the adjacent land. All culverts which convey runoff across site boundaries were measured in the field, and their capacities estimated. A comparison of culvert capacity and estimated peak flow at each culvert (resulting from a given storm) allowed a preliminary assessment of whether or not a specific roadway will be overtopped. Overtopping of outlet culverts indicates a need for an improved culvert to prevent a potential back-up of water onto the site. Swales and channels on and downstream from the sites were observed. Their slopes were estimated from topographic mapping to assess whether or not they have sufficient capacity to convey runoff away from the site.

A distinction is drawn between inlet culverts, which convey water onto a site, and outlet culverts, which convey water off a site. Of concern is the capacity of the outlet culverts because they may contribute to flooding on the site. In comparison, inadequate inlet culvert capacity would cause flooding upstream from and adjacent to (but not on) a site.

The data collected were considered sufficient to assess the relative flood susceptibility of the sites for comparative evaluation purposes. Detailed analyses of each of the sites (hydrologic and hydraulic modelling) were not considered necessary at this stage. A comprehensive analysis of surface drainage will be undertaken in Phase 4B when a preferred site

or sites has been selected. This approach is consistent with proceeding at an increasing level of detail as the number of candidate sites is reduced.

The results of the flood susceptibility analysis are presented in Chapters 3 through 10 of this volume. The detailed comparative evaluation of sites on the basis of flood susceptibility is presented in the main part of this report (GLAL, 1985a).

2.4.2 DRAINAGE IMPROVEMENT CONSIDERATIONS

Development of any of the candidate sites as a hazardous waste facility may have an impact on the existing on-site and off-site drainage systems.

Development of any of the sites selected for landfilling (i.e. LF-2N, LF-4N, LF-3C, LF-9C and LF-1E) would result in more significant changes to the existing drainage patterns than would the development of a physical-chemical/ incineration site (i.e. PI-1N, PI-13N and PI-27E). Potential impacts and the means of overcoming these changes are summarized below.

- The construction of the landfill will alter the existing on-site drainage swales and patterns, and will require construction of new drainage facilities, including perimeter ditching around the site.

- Runoff from upstream areas, which presently drains through the site, may have to be re-routed around the site in perimeter ditches.

- Increased flow rates downstream from the site, as a

result of site development, may require downstream swale, channel and structure improvements to ensure that flood levels are not increased. The improvements could include the replacement of culverts and bridges with ones of larger capacity, the raising of road beds and the channelization of swales and watercourses. Channelization could include the widening and/or deepening of existing watercourses with consideration given to the protection of erodible surfaces.

- Storm water management ponds may be constructed to decrease post-development flow rates to pre-development levels, thereby reducing or eliminating the need for downstream channel improvements.

Several sites (PI-13N, PI-1N and PI-27E) are being considered for the treatment facility alone, i.e. physical-chemical treatment plant and/or incineration plant. It is anticipated that the effect of the treatment facility on runoff will be minor relative to the effect of the landfill as described above. The treatment facilities alone will have little effect on site slopes and will involve development of only a small portion of the site. Therefore, post-development flow rates are not expected to increase significantly beyond pre-development levels. Drainage improvements may only be required at these sites to eliminate a potential flood threat or to route runoff from upstream areas around the facility. Downstream improvements or stormwater management ponds to offset increased flows will be relatively minor considerations.

The 1:10,000 scale mapping and site visits were the primary sources of data used in the assessment of potential

drainage system improvements required at each site. The walk-and-talk questionnaires, 1:50,000 scale topographic mapping and aerial photography also proved useful.

For comparison purposes, preliminary estimates were made of the potential increase in peak runoff rates from the sites after development. The general scope of on-site works required to effectively drain the site were identified. Further, the scope of off-site drainage works to accommodate increased runoff from the sites, without increasing downstream flood levels, has been considered qualitatively (assuming uncontrolled release of storm runoff from the sites).

Subsequent to this comparison, on-site storm water detention ponds have been incorporated into the facility design to reduce peak flows to pre-development levels (Site Selection Process, Phase 4A: Selection of a Preferred Site(s) - Engineering; Monenco, 1985b).

Limitations of available data allow a very preliminary assessment of the drainage improvements required at each site. However, these data were satisfactory for making relative comparisons of required improvements. A much more detailed analysis will be required to confirm the on-site and off-site impacts of site development and the scope of remedial measures required to mitigate the potential impacts.

The results of the drainage improvement considerations analysis were provided to Monenco and incorporated into their preliminary facility cost estimates.

For each candidate site, discussions were held with Monenco

Limited regarding the preferred location of the outfall from the onsite stormwater system. Recommendations made by GLAL have been confirmed by Monenco and incorporated into their Phase 4A facility design work (Monenco, 1985b).

2.4.3 WATER USE

The purpose of identifying and documenting surface water use was to establish the information base necessary to permit the detailed comparative evaluation of the candidate sites on the basis of the potential impact on surface water use from the OWMC waste treatment facility.

IDENTIFICATION OF SURFACE WATER USES

Using the data sources discussed in Section 2.3, surface water uses were identified and plotted on 1:50,000 scale regional maps and 1:10,000 scale maps for each candidate site. These maps have been reduced in scale for publication in this volume.

Municipal and industrial intakes and outfalls were obtained from earlier work (Surface Waters of the Golden Horseshoe as Effluent Receivers (PHASE 3 - INTERIM); GLAL and Gore & Storrie Limited, 1984) This information was updated during contacts with staff of the Ontario Ministry of the Environment (MOE).

MOE's Permit To Take Water (PTTW) files were used to identify large consumers of surface water for uses such as irrigation and recreation. These permits are only issued for usage greater than 45,460 litres per day (10,000 imperial gallons per day), thus many smaller users cannot be identified through this source. In many cases permits had expired. However, it was assumed for comparative evaluation purposes that these uses still occur (Personal Communication, J. Berrendson, Central

Region, Ontario Ministry of the Environment, 1984). In a few cases the description of the location of the taking on the permit was missing or incomplete, thus it was not possible to plot these uses.

The walk-and-talk questionnaires and site tours provided valuable information on local water uses. Where possible, information obtained through the questionnaires was verified during a field visit.

To provide an indication of the extent of low volume and other sensitive water uses downstream from the study areas, streams passing through rural, wooded and recreational land were identified and measured on 1:25,000 scale topographic maps. It was assumed that these land uses were often associated with low volume sensitive users, e.g. potable water supplies in rural and recreational areas, crop irrigation and livestock watering in rural and wooded areas. Urban and industrial land uses were not considered to be "sensitive use" because water is normally supplied from municipal water supply systems in these areas. It was therefore concluded that the total stream length through rural, wooded and recreation land would provide a simple index of the extent of potential sensitive water use. This was expressed as the "Downstream Water Use Index" (DSWUI) and was used to allow inter-site water use comparisons.

When considering water use in the regional study area the DSWUI was calculated for streams downstream from the projected storm water outfall for each site. In the access route (regional) study area, several tributaries of a river system may be crossed by an access route. Sensitive uses in the downstream parts of these watersheds would be exposed

to a potential risk at each stream crossing in the unlikely event of an accidental spill occurring at a crossing. This cumulative risk was evaluated through an aggregation of the downstream water use (i.e. stream lengths through land uses with sensitive water use) below each crossing along an access route.

Water use information for the site, site vicinity and regional study areas is contained in Sections 3 through 10 of this Technical Appendix. The detailed comparative evaluation of siting options on the basis of water use is contained in the main part of this report (GLAL, 1985a).

2.4.4 ACCESS ROUTES

The purpose of the access route analysis was to obtain a measure of the potential of waste entering the surface water system in a transportation spill event involving a vehicle transporting hazardous liquid wastes*. This spill information and the information concerning surface water usage, downstream of access route crossings formed the basis for the comparative evaluation (surface water) of alternative access routes to a particular site. The comparative evaluation was undertaken to aid in the selection of a preferred route as part of a a refinement of siting options - see Section 2 of the main part of this report (GLAL, 1985a).

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* In this discussion a transportation spill means either a transportation accident involving a vehicle that results in a hazardous waste spillage, or an in-transit spill resulting from a loss of of containment (container failure). The estimation of the likelihood of a transportation spill event involving a vehicle transporting hazardous liquid wastes may be found in Site Selection Process, Phase 4A: Selection of a Preferred Site(s) - Transportation; M.M. Dillon Limited, 1985b.

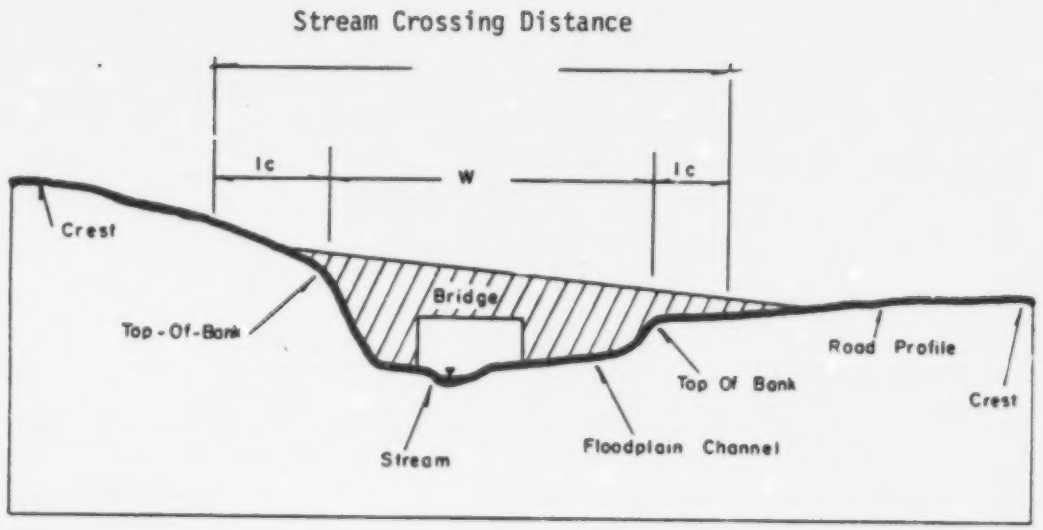
The information about the preferred access route(s) was carried forward for the comparative evaluation of siting options (see Section 3 of the main report (GLAL, 1985a)).

A measure of the potential of the entry of waste into the surface water system from a spill event involving a vehicle along an access route was provided by a term called "Stream Crossing Distance". This distance was the length of access route where there is a high risk of contaminants entering a stream as a result of a spill.

The stream crossing distance consists of two components (Figure 21). The first component, "w", was determined by identifying the top-of-bank floodplain on 1:25,000 scale N.T.S. topographic maps and measuring the length of the access route that passes through the floodplain. A spill occurring in this floodplain area could easily result in direct entry of wastes to a stream with no opportunity for containment. The second component, "lc", is known as the critical overland flow length. An in-transit spill event occurring within this distance would not result in immediate entry of wastes to a stream. However, liquid wastes could flow along the road surface or in the roadside ditches and could reach the stream before emergency response crews could contain the spill.

The first step in determining the "lc" component of the stream crossing distance was the calculation of overland flow velocity. This value was calculated using standard engineering nomographs for overland flow (Storm Drainage Criteria Manual, City of Burlington; M.M. Dillon Limited, 1977), and surface slopes as measured from 1:25,000 scale N.T.S. topographic maps.

Figure 21 SCHEMATIC DIAGRAM SHOWING THE STREAM CROSSING DISTANCE IN THE EVENT OF AN ACCIDENTAL SPILL OF CONTAMINATED MATERIAL ALONG AN ACCESS ROUTE



CROSS SECTION

The total Stream Crossing Distance was then determined by summing the individual "w" and "lc" distances for each access route segment. The lower the total stream crossing distance, the lower the chance of entry of a spill to a surface watercourse along that route.

Stream crossing distance data are presented in Sections 3 through 10 of this Technical Appendix for each candidate site. The main volume of this report presents the detailed comparative evaluation of candidates sites with respect to preferred access routes (GLAL, 1985a).

2.4.5 RAIL ACCESS

The purpose of rail access analysis was to evaluate rail access options to the candidate site from the surface water perspective. This analysis resulted in recommendations for preferred rail access routes. The study area for this analysis consisted of broad corridors from the closest main rail line to the site boundary. In most cases the study area was entirely within the site vicinity. In the case of PI-13N major rail lines were more remote from the site; therefore, a regional study area was included as well.

The data collection effort consisted of constraint mapping. The mapping was then carried forward to the comparative evaluation (Section 2 in the main report, GLAL, 1985a).

During the constraint mapping stage surface water factors as well as those from other disciplines, were noted in the assessment of broad transportation corridors. These corridors were identified by the transportation consultant and are described in M.M. Dillon Limited (1985b). The outcome of the

constraint mapping exercise was the identification of constraints affecting the location of rail access and the identification of specific rail access alignment options for further consideration.

Constraint Mapping. The rail access constraint mapping step involved the preparation of 1:10,000 scale constraint maps, showing streams and floodprone areas. This information was prepared on overlays and provided to the site selection team. Copies of these working maps are on file with GLAL. The data for these analysis were derived from existing site and site vicinity investigations.

Study areas provided by the transportation consultant (M.M. Dillon Limited, 1985b) extended from the existing main rail line corridor to the acquisition limit of the candidate sites. The number of stream crossings was determined by overlaying the surface water constraint map onto the rail access study zones map. Stream crossings were counted and major floodplains, flood-prone areas, and wetland areas noted. The surface water data were used along with data provided by other disciplines, to highlight specific constraints and identify rail alignment options that warranted examination in more detail.

The data collected during the constraint mapping was carried forward for evaluation in Section 2 of the main volume of this report (GLAL, 1985a).

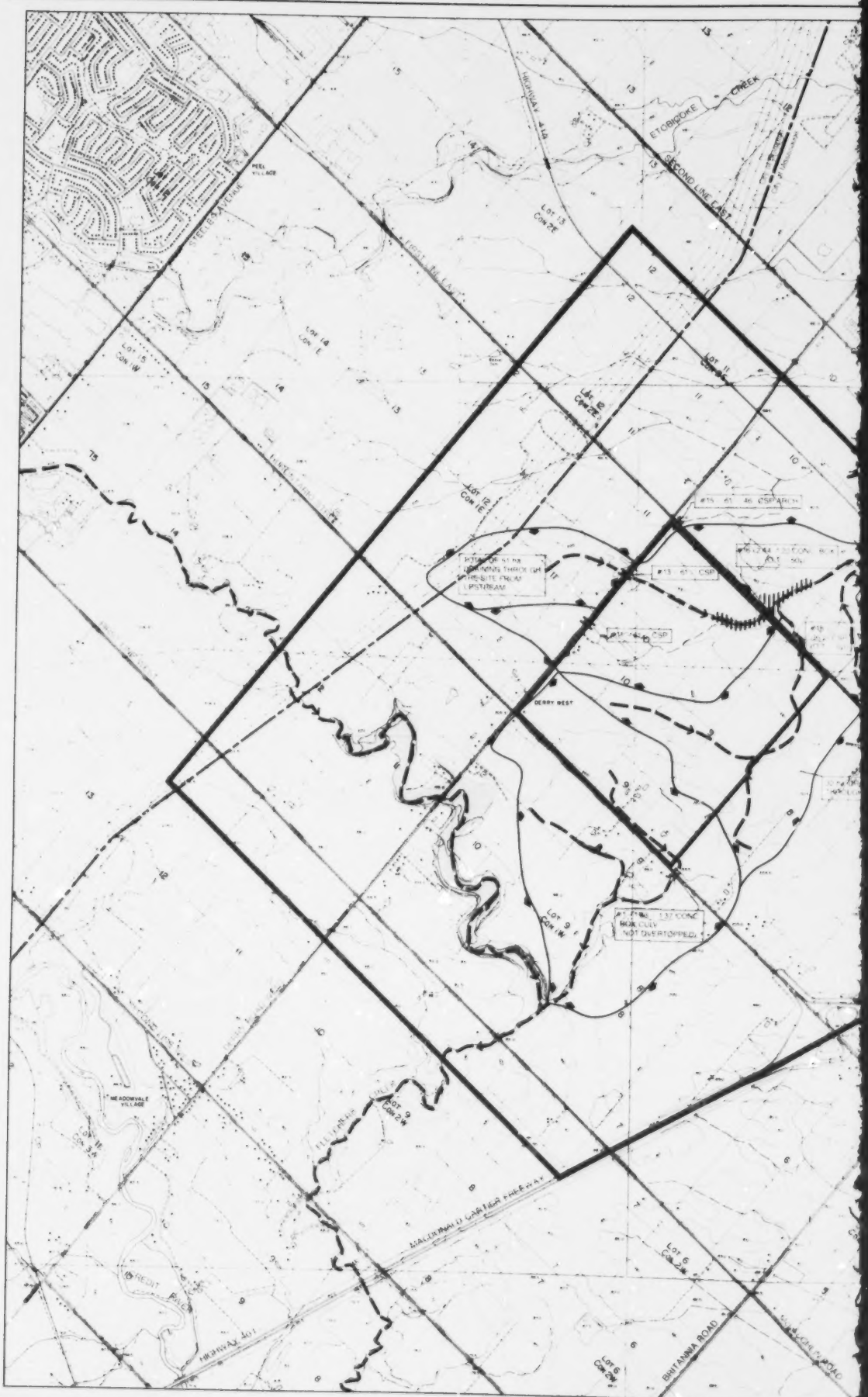
3.0 CANDIDATE SITE LF-2N SURFACE WATER CONSIDERATIONS

3.1 FLOOD SUSCEPTIBILITY

Site LF-2N is characterized by good topographic relief, and is generally well drained. The highest topographic elevation of 201 m above sea level (a.s.l.) occurs along a weak ridge through the western half of the site. From here, the land slopes eastward, falling to elevation 192 m a.s.l. along the eastern boundary. The ridge, which runs north-south, forms part of the boundary between two major watersheds. The western one-third of the site is drained by a tributary of Fletcher's Creek, which comprises part of the Credit River watershed. Fletcher's Creek floodplain has been mapped by the Credit Valley Conservation Authority as shown on Figure 22. The site is located well outside the Fletcher's Creek floodplain limits. The eastern portion of the site is drained by two small tributaries which drain into the main branch of Etobicoke Creek, approximately 3.1 km east of the site. The site is well above the Etobicoke Creek floodplain to the east and north. There are no major watercourses to the south which could cause site flooding.

A minor flood-prone swale flowing beneath Kennedy Road has been identified from aerial photograph interpretation of the site. However, this flood-prone swale is considered to be of little significance to development of this site as a landfill for treated wastes.

Three outlet culverts were identified during field visits


ETOBICOKE CREEK
SECOND LINE EAST
HIGHWAY 410
MEEL AVENUE
MEEL VILLAGE
LOT 13 CON 2E
LOT 14 CON E
LOT 15 CON 1W
LOT 12 CON 1E
LOT 11
LOT 10 CON 2E
#15 CSP
#13 CSP
#10 CSP
DERRY WEST
LOT 9 CON 1W
#7 CSP
NOW CULV
NOT OVERTOPPED
MEADOWVALE VILLAGE
LOT 9 CON 3W
LOT 9 CON 2W
HILLSBURGH
CREDIT RIVER
HIGHWAY 401
LOT 6 CON 3W
LOT 6 CON 2W
BRITANNIA ROAD

OWMC Ontario Waste Management Corporation

Consultant: DILLON

Gartner Lee Associates Limited

Legend:

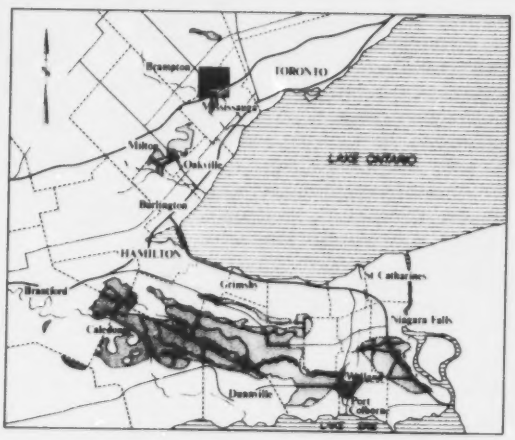
- Regional Storm Floodplain
- Flood-Prone Area
- Channel or Swale
- Watershed Divide
- Culvert or Bridge Crossing
- Crossing Overtopped For Estimated Flow (Inlet Control)
- Corrugated Steel Pipe
- Culvert Identification Number, Size (m) and Type

Note: All Culvert Dimensions in Meters

Phase 3B Acquisition Boundary — Site Vicinity Study Area Boundary

Key Map: LF-2 North

Lots 9 and 10; Concession 1 EHS (East of Hurontario Street), City of Mississauga



1000 feet 0 1000
500 metres 0 500

Existing Surface Water Conditions
PHASE 4A

Surface Drainage: LF-2N

October 1985

FIGURE 22

to this site. The drainage areas, culvert sizes, flow estimates etc., at each outlet culvert are shown in Table 2. The culvert numbers (column 2) are referenced to Figure 22. Comparison of flow estimates with culvert capacities indicates that two of the three roadways will be overtopped at the culverts under existing conditions for the 100 year return period storm flow. Overtopping of the road in the vicinity of the culverts indicates a potential for the backing-up of flood waters onto the site. It is estimated that flooding due to inadequate culvert capacity may be limited to local areas in the vicinities of the culverts. However, the severity of site flooding which this may cause cannot be accurately determined without much more detailed topographic data.

In general, the 100 year return period peak flow estimates at the site outlets are relatively low (3.5-7.5 m^3/s for 100 year return period storm) because there is very little upstream area contributing runoff through the site. This suggests that outlet culverts and downstream swales need not be very large to ensure that the site is not flooded. Preliminary estimates of downstream swale slopes (0.8 - 1.2%, based on 1:10,000 topographic mapping) indicate that flooding from insufficient downstream swale capacities is not likely.

3.2 DRAINAGE IMPROVEMENT CONSIDERATIONS

As is the case for all of the landfill sites, the existing swales and drainage patterns would be eliminated due to the landfill and associated construction activities, e.g. site grading. The on-site drainage system would be improved by constructing perimeter ditches near the site boundaries.

TABLE 2 FLOOD SUSCEPTIBILITY DATA: LF-2N

No. of Outlets	Outlet Ref. # (see Fig. 22)	Drainage Area to Outlet (ha)	Size of Outlet (m)	Capacity of Outlet at: Top of Road (m^3/s)	Capacity of Outlet at: Obvert (m^3/s)	Flow Estimates (m^3/s) Q5 *	Q10 *	Q50 *	Q100 *	Approx. Slopes of Outlet Swales (%)
3	16	118	2.4 x 1.2 Box	7.0	4.3	4.5	5.2	6.9	7.5	0.8
	18	84	0.7 Ø CSP **	0.48	0.42	3.3	3.9	5.2	5.7	0.8
	1	48	1.8 x 1.4 Box	8.5	4.1	2.0	2.4	3.1	3.5	1.2

* 5, 10, 50, 100 refers to the length (years) of the return period of the storm under consideration.

** Corrugated Steel Pipe

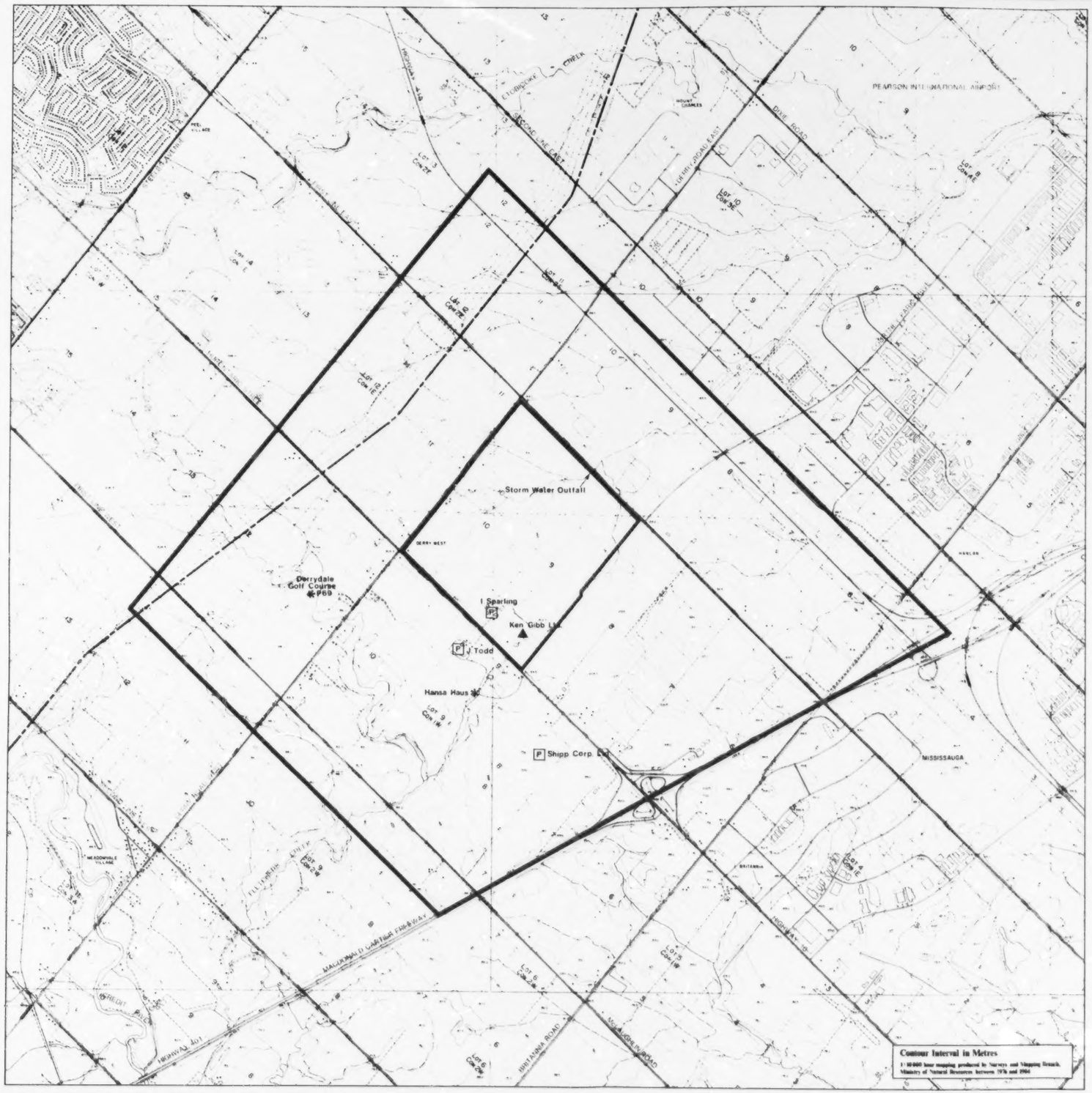
The size of perimeter ditches would be minimized by using two principal outlets to drain the site, as at present. However, this would result in site runoff discharging into two separate major watersheds. Diversion of all site drainage into Etobicoke Creek is feasible, but will require substantially larger perimeter ditching, particularly where the drainage divide between the two watersheds is crossed.

Should a landfill be developed on this site, peak flows are expected to increase significantly and some downstream channelization and culvert improvements may be required. Specifically, channelization lengths of 2,000 m and 1,000 m may be required downstream from Kennedy Road and Hwy 10, respectively. Four structures may require replacement in these reaches to accomodate runoff from the landfill.

Control of peak flows from the site to pre-development levels could be accomplished with on-site detention storage. The required storage volume to control the 100 year return period runoff to pre-development peak flows is approximately 28,000 m^3.

Interviews with landowners indicate that none of the site is tile-drained and therefore tile drain removal may not be required.

Following discussions between GLAL, and Monenco Limited about the on-site surface drainage of the site it was recommended that the projected stormwater outfall would be located at the unnamed tributary of Etobicoke Creek near the mid point of the northeastern side of the site. This location is at Culvert #16 on Figure 22 and is shown on Figure 23.



OWMC Ontario Waste Management Corporation

Consultant: Gartner Lee Associates Limited

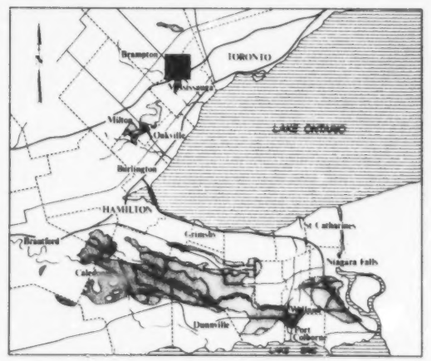
Legend:

- Municipal Intake
- Municipal Outfall
- Industrial Intake
- Industrial Outfall
- B Recreation : B - beaches, S - swimming, Bt - boating, W - Winter Sports, P - Pond
- Rural Potable Supply
- Nonpotable Domestic Supply
- Livestock Watering (stream or pond)
- Irrigation - P71 M.O.E. Permit To Take Water
- P Farm Pond Unspecified Use or Unused
- U Stream Taking - Unspecified Use

Phase 3B Acquisition Boundary — Site Vicinity Study Area Boundary

Key Map: LF-2 North

Lots 9 and 10; Concession 1 EHS (East of Hurontario Street), City of Mississauga



1000 feet 0 1000
500 metres 0 500

EXISTING SURFACE WATER CONDITIONS, PHASE 4A

Local Surface Water Use

October 1985 FIGURE 23

3.3 SURFACE WATER USE

The watercourses that may potentially be effected by the development of site LF-2N (i.e., surface water use interference) consisted of portions of Fletcher's Creek, Cooksville Creek and Etobicoke Creek that are downstream from the proposed landfill and/or physical/chemical treatment plant and/or access routes. This area (shown in Figure 2) terminates at Lake Ontario.

3.3.1 LOCAL WATER USE

The results of the walk-and-talk program and discussions with local residents identified some minor uses of surface waters on the site and in the area adjacent ot the site and access roads, see Figure 23. The findings of the walk-and-talk questionnaire about surface water uses are summarized in Table 3.*

The walk-and-talk program did not identify any potable or nonpotable domestic use of surface water downstream from the storm water outfall within the site vicinity.

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* At the time of the walk-and-talk and other data collecting activities (summer and fall, 1984) the location of the storm water outfall had not been finalized. Consequently, local surface water use data were collected for all the streams downstream from the site. All of the data collected are shown on local surface water use figures of this report. For the purposes of comparative evaluation (GLAL, 1985a), only those uses of surface water downstream from the projected storm water outfall with the site vicinity (study area) were counted.

TABLE 3 SUMMARY OF LOCAL SURFACE WATER USE: LF-2N

Individuals Interviewed	Assessment Roll No.	Site (S) or Site Vicinity (SV)	Interview No., GLAL Field Visit No. (FV)	Surface Water Use Comments
Dr. I. Sparling	117-076-00	S	218-2	pond described as stagnant, no use indicated
German Canadian Club (Hansa Haus)	96-037	SV	72-1	pond & stream takings to water gardens
J. A. Todd	96-034	SV	241-2	pond used for unspecified purposes
W. & P. Acri	117-248 117-077	S S	283	no use indicated no use indicated
H.C. Nugent	96-040	SV	IER-4	drainage creek crosses property, no use indicated
R.F. Kilpatrick	96-039-00	SV	137-1	no use indicated
P. Lavin	117-246-10	S	32-1	no use indicated
W.W. Golden	117-248-00	S	26-1	no use indicated
S. Casar	117-241-00	SV	34-1	no use indicated
W. Stocks	117-039-00	SV	74-1	natural runoff waterway on property, no use indicated
D. Jeffries	117-074	SV	36-1	no information available
Knob Hill Farms Ltd.	98-261	S	76-2	no use identified
Seven-Don Holdings	98-260	S	76-2	stream crosses property, good fresh water noted, no uses indicated
Ken Gibb Ltd.	117-075	S	50-2 FV	farm pond noted during field visit livestock watering observed (ducks, geese)
Mr. Aulakh	117-242	SV	214-1	no streams, no ponds
Shipp Corp. Ltd.	96-077 96-041	SV	264-2	no use indicated pond noted on topographic maps

(cont'd...)

TABLE 3 SUMMARY OF LOCAL SURFACE WATER USE: LF-2N

Individuals Interviewed	Assessment Roll No.	Site (S) or Site Vicinity (SV)	Interview No., GLAL Field Visit No. (FV)	Surface Water Use Comments
D. Drysdale	96-027	SV	436	no information available
Mr. & Mrs Anacleto	96-036	SV	70-1	no use indicated
D.S. McClure	117-075 117-074 96-041 96-077 117-021 117-020	S SV	706	no use indicated
E. Scace	117-248	SV	IER#3	Stream on property, no use indicated

The walk-and-talk data base indicated that Fletcher's Creek was used for irrigation purposes at three places. However, only one of these was situated downstream from the site. Some farm ponds on, and in the vicinity of the site were used for livestock watering. The walk-and-talk program did not identify anyone using the water from the local Etobicoke Creek system. The main source of water for both domestic and agricultural supply on the site and in the site vicinity appears to be wells (Site Selection Process, Phase 4A: Selection of a Preferred Site(s) - Geologic, Hydrogeologic and Geotechnical Considerations, GLAL, 1985b).

On the basis of the information collected, the potential for interference with surface water uses in the immediate site area appears to be very low. Surface water users on the site would be displaced by site development and upstream users would not be effected by accidental discharges to local streams. Only one use of surface water for agricultural purposes was identified in the study area. No use of stream water was identified downstream from the storm water outfall within the site vicinity.

3.3.2 REGIONAL WATER USE

On a regional scale, five MOE PTTW were identified downstream from candidate site LF-2N and its preferred access routes (Figures 2 and 23). Three permits were located on the Credit River and one each on Cooksville Creek and Etobicoke Creek. All of the permits were issued for irrigation purposes (e.g. orchard, golf course). Only one permit (83-P-268) lies downstream from the stormwater outfall of this site. The permits are summarized in Table 4. No municipal or industrial water taking permits were identified.

TABLE 4: SUMMARY OF PERMITS TO TAKE WATER: LF-2N

PERMIT NO.	STREAM	PURPOSE	MAXIMUM DAILY AMOUNT (m^3)
38-P-3050	Credit River	Irrigation (unspecified)	586
67-P-396	Credit River	Irrigation (orchard)	2,038
65-P-24	Credit River	Irrigation (golf course)	1,064
64-P-369	Cooksville Creek	Irrigation (golf course)	275
73-P-268	Etobicoke Creek	Irrigation (golf course)	2,182

A measure of sensitive surface water usage downstream from the proposed storm water outfall is given by the DSWUI. It is a measure of the length of stream through land uses with low volume, sensitive water use, downstream from the projected storm water outfall of the site. The location of the outfall is shown in Figure 23. The DSWUI for LF-2N is 12.5. Part A of Table 5 shows the distribution of this index among the land uses with sensitive water use. Part B of Table 5 shows the distribution of land uses with sensitive water use which comprise the Index for the access route study area at LF-2N. The preferred access route DSWUIs range from 25.5 to 338.0. Note that the study area for the access route DSWUI consists of the streams between access roads and Lake Ontario.

TABLE 5: DOWNSTREAM WATER USE INDEX: LF-2N

STUDY AREA	LAND USE			DOWNSTREAM WATER USE INDEX
	WOODED	RECREATIONAL	RURAL	
A. Regional: Stormwater Outfall	5.1	2.3	5.1	12.5
B. Preferred Access Routes: To LF-2N:				
From Hwy 401:	4.6	4.5	19.9	29.0
From Hwy 410:	10.3	4.5	10.7	25.5
LF-2N to Hwy 401 to PI-13N:	207.2	37.0	84.7	328.9
LF-2N to Hwy 401 to PI-1N:	204.4	38.0	95.6	338.0

3.4 PREFERRED ACCESS ROUTES

The preferred access routes to candidate site LF-2N were identified by the site selection team during Phase 3B. The data collected during Phase 4A refer to the preferred route.

A measure of the likelihood of waste entry into the surface water system as a result of an accident involving a vehicle along an access route was obtained by measuring Stream Crossing Distance (SCD) (see Section 2.4.4). This distance is the length of access route where there is a high likelihood of contaminant entry to a stream should an accidental spill occur. SCDs are presented in Table 6 for the preferred access routes to LF-2N, between LF-2N and PI-1N, and PI-13N.

TABLE 6: STREAM CROSSING DISTANCES FOR ACCESS ROUTES: LF-2N

PREFERRED ACCESS ROUTE	STREAM CROSSING DISTANCE (m)
To LF-2N:	
From Hwy 401	905
From Hwy 410	460
LF-2N to Hwy 401 to PI-13N:	2,230
LF-2N to Hwy 401 to PI-1N:	2,615

3.5 RAIL ACCESS

Rail access to LF-2N crosses 6-7 streams to the west of the site, depending on the alignment chosen. Two major floodplains are crossed -- Credit River and Fletchers Creek. No rail access options were identified (Site Selection Process, Phase 4A: Selection of a Preferred Site - Site Selection; M.M. Dillon Limited, 1985c).

3.6 SUMMARY OF FINDINGS

Flood Susceptibility

- Site LF-2N is characterized by good topographic relief and is generally well drained.

- No part of the site is located on designated floodplain land.

- There is a relatively small upstream drainage area contributing runoff which must be conveyed through the site.

- Inadequate outlet culvert capacities will not likely result in significant flooding of the site under existing conditions.

- Outlet swales have sufficient slope so that runoff can be conveyed away from the site without causing a backwater effect.

Drainage Improvements

- On-site drainage can be conveyed to outlets beneath Kennedy Road and Hwy 10 via perimeter ditching; alternatively all site runoff could be routed to Etobicoke Creek via the culvert at Kennedy Road.

- Runoff from the upstream area draining through the site is minor and can be re-routed around the perimeter of the site to the Kennedy Road culvert.

- A total of 3,000 m of downstream channelization may be required to ensure water levels are not increased after the site is developed.

- Four downstream culverts may need to be replaced to accommodate increased flows.

- On-site storm water management ponds may be used to reduce post-development flows to pre-development levels.

- The recommended storm water outfall location is at Culvert #16 on First Line East.

Water Use

- Local water use is considered to be minor.
- One Permit To Take Water was identified downstream from the recommended storm water outfall location.
- No surface water is used locally for potable supply.
- Regional use of surface waters is mainly for irrigation purposes.
- There are no municipal water supply intakes downstream from the site or access route crossings.
- The DSWUI is 12.5.

Access Routes

- There are no major stream crossings.
- The SCDs range from 460 to 2,615 m.
- The access road DSWUIs range from 25.5 to 338.0.

Rail Access

- Two major floodplains lie within the rail study area.

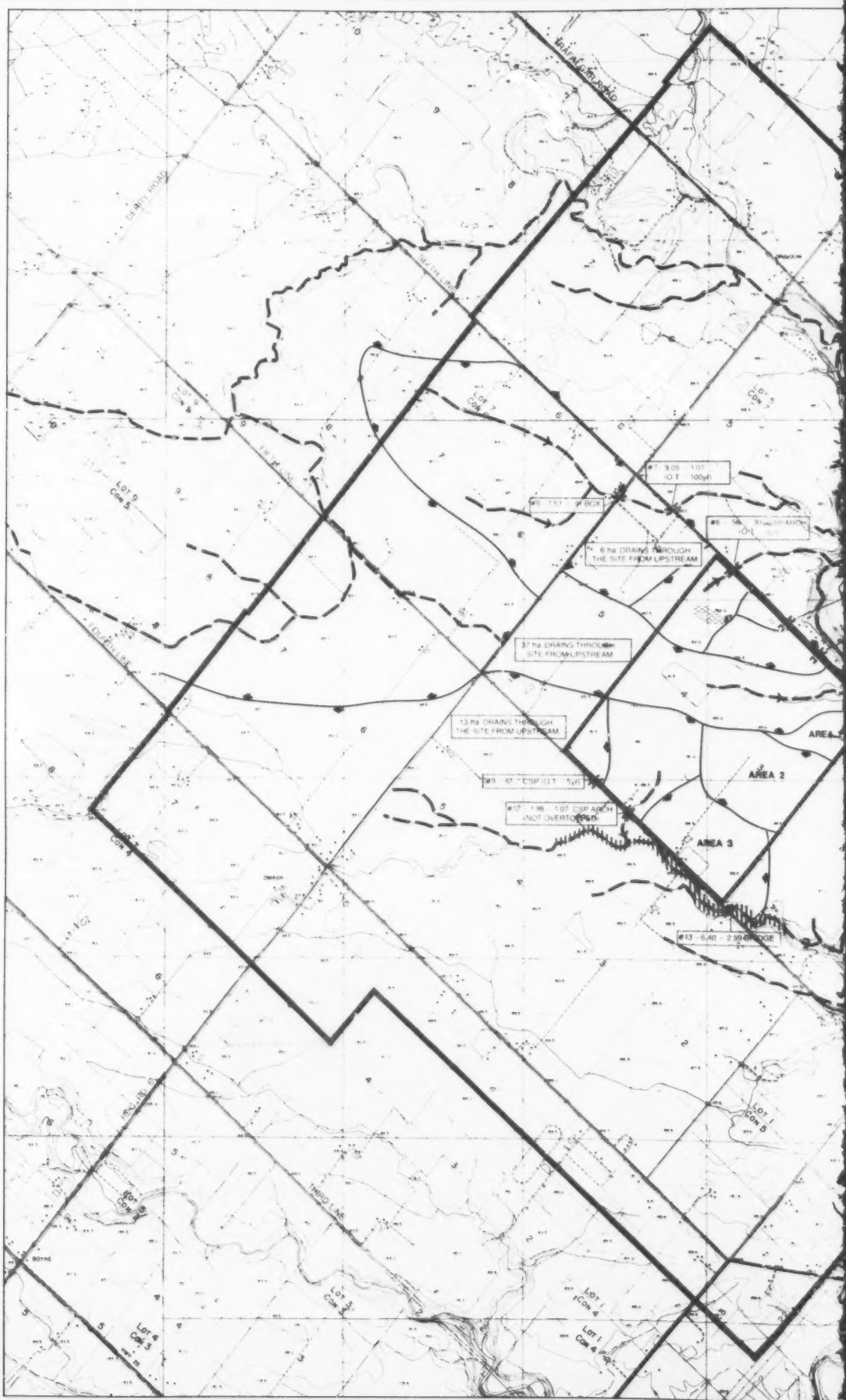
4.0 CANDIDATE SITE PI-13N SURFACE WATER CONSIDERATIONS

4.1 FLOOD SUSCEPTIBILITY

This site is characterized by good topographic relief and is generally well drained. The western portion of the site drains via shallow field swales in a southwest direction to a well defined tributary of Sixteen Mile Creek. The eastern half of the site is also drained by shallow field swales in a southeast direction to the East Sixteen Mile Creek (East Oakville Creek), (Figure 24).

The deeply incised East Sixteen Mile Creek valley is located to the south and immediately to the east of the site. Preliminary mapping of the Regional Storm Flood prepared for the Halton Region Conservation Authority has been used to show the floodplain of Sixteen Mile Creek in the vicinity of the site. It is expected that the Regional Storm floodplain will be confined to the valley, and will not encroach upon the site. The tributary which drains the western half of the site is located immediately adjacent to the west site boundary. The floodplain of this tributary has not been mapped, but it too is expected to have sufficient capacity to prevent site flooding. There are no major watercourses to the north which could cause site flooding. Other flood-prone areas are shown on Figure 24.

Six outlet culverts and three additional overland outlets have been identified from field visits and from topographic mapping. Drainage areas, culvert sizes and flow estimates, are shown in Table 7. The culvert and area numbers are referenced to Figure 24. Comparison of flow estimates with


6 ha DRAINS THROUGH THE SITE FROM UPSTREAM
37 ha DRAINS THROUGH SITE FROM UPSTREAM
13 ha DRAINS THROUGH THE SITE FROM UPSTREAM
AREA 2
AREA 3
THIRD LINE
LOT 9 CON 5
LOT 7 CON 5
LOT 5 CON 5
LOT 3 CON 5
LOT 1 CON 5
LOT 4 CON 3
LOT 3 CON 4
LOT 1 CON 4
LOT 1 CON 4 (NS)

OWMC Ontario Waste Management Corporation

Consultant: DILLON

Gartner Lee Associates Limited

Legend:

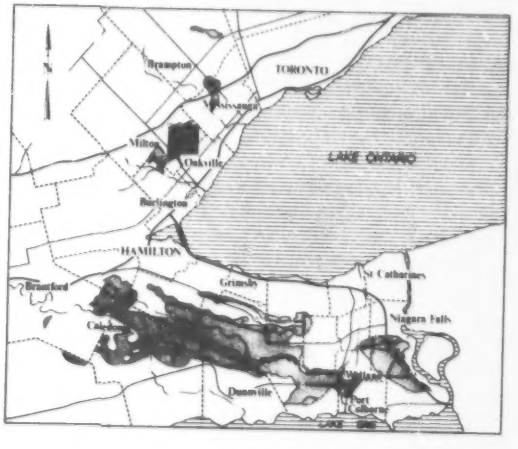
- Regional Storm Floodplain
- Flood-Prone Area
- Swamp or Low Lying Area
- Channel or Swale
- Watershed Divide
- Culvert or Bridge Crossing
- Crossing Overtopped For Estimated Flow (Inlet Control)
- Corrugated Steel Pipe
- Culvert Identification Number, Size (m) and Type

Note: All Culvert Dimensions in Meters

Phase 3B Acquisition Boundary — Site Vicinity Study Area Boundary

Key Map: PI-13 North

Lots 3 and 4; Concession VI; Town of Milton, formerly the Township of Trafalgar



1000 feet 0 1000
500 metres 0 500

Existing Surface Water Conditions
PHASE 4A

Surface Drainage: PI-13N

October 1985

FIGURE 24

TABLE 7 FLOOD SUSCEPTIBILITY DATA: PI-13N

No. of Outlets	Outlet Ref. # (see Fig. 24)	Drainage Area to Outlet (ha)	Size of Outlet (m)	Capacity of Outlet at: Top of Road (m^3/s)	Capacity of Outlet at: Obvert (m^3/s)	Flow Estimates (m^3/s) Q5 *	Q10 *	Q50 *	Q100 *	Approx. Slopes of Outlet Swales (%)
9	2	81	1.21 Ø CSP**	3.54	1.84	3.0	3.6	4.7	5.2	Sixteen Mile Creek Valley
	3	12	0.76 Ø CSP	1.56	0.59	1.0	1.3	1.7	1.8	0.8
	4	4	0.69 x 0.46 Arch	0.54	0.28	0.5	0.5	0.7	0.8	0.7
	6	20	0.56 x 0.31 Arch	0.28	0.14	1.7	2.0	2.6	2.9	0.7
	9	21	0.61 Ø CSP	0.42	0.34	1.4	1.7	2.2	2.4	0.8
	12	25	1.98 x 1.10 Arch	5.66	3.11	1.9	2.2	2.9	3.2	0.6
	Area 1	8	-	-	-	1.0	1.1	1.5	1.6	1.3
	Area 2	27	-	-	-	2.0	2.3	3.1	3.4	0.6
	Area 3	31	-	-	-	2.6	3.0	4.0	4.4	0.8

* 5, 10, 50 & 100 refer to the length (years) of the return period of the storm under consideration.
** Corrugated Steel Pipe

culvert capacities indicates that all roadways except Culvert #12 will be overtopped by the estimated 100 year return period storm under existing conditions. The overtopping of roadways at outlet culverts indicates inadequate culvert capacity and a potential for the backing up of flood waters onto the site. However, considering the topography of this site, site flooding due to inadequate culvert capacity is expected to be confined to local areas in the vicinity of the culvert structures. This will be assessed more fully in Phase 4B, should this site remain under consideration.

In general, the 100 year return period peak flow estimates at the site outlets are relatively low (0.76-5.21 m^3/s) because of the small upstream area contributing runoff through the site. This suggests that with sufficient slopes, downstream swales need not be very large to convey runoff away from the site without causing a backwater effect.

4.2 DRAINAGE IMPROVEMENT CONSIDERATIONS

Site PI-13N is being considered only for the siting of the physical chemical treatment plant and/or incineration plant, and not for a landfill. Thus, as indicated in Section 2.4.2, drainage improvements required to make this a safe site from a flooding perspective are much less significant than for landfill sites.

Specifically, the low susceptibility of this site to flooding indicates that no major improvements would be required in the vicinity to lower flood levels or protect the site by other means (berms, regrading, etc.). The facility will have little effect on existing drainage patterns. It could be located on a

ridge of high land in the middle of the site, such that only very minor perimeter ditching is required to re-route local runoff around the site.

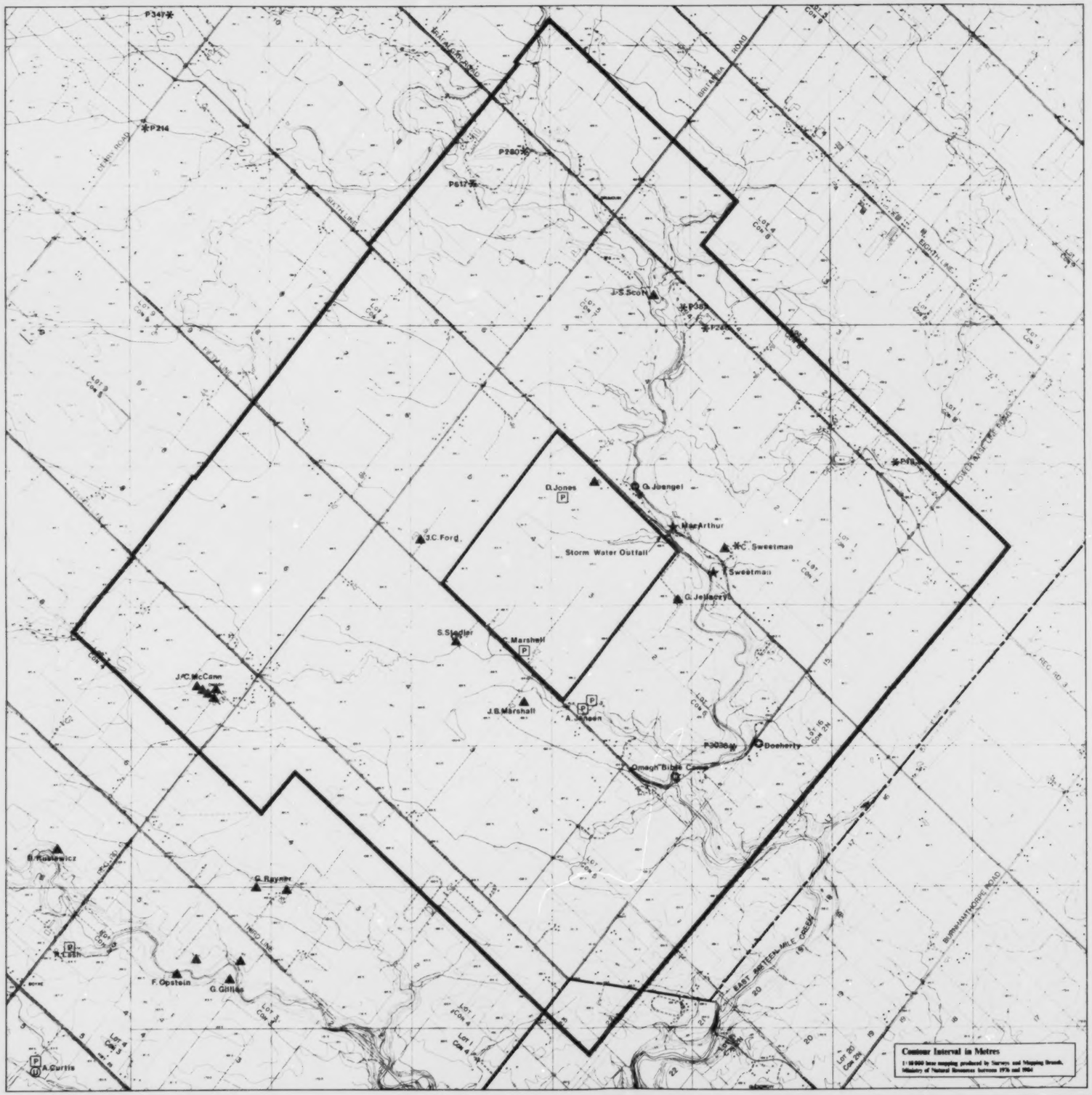
It is expected that the existing conditions of peak flows will not be significantly increased after the site is developed and therefore no downstream channel or structure improvements (or alternatively, storm water management ponds) would be required.

Interviews with landowners indicate that none of the site is tile drained and therefore tile drain removal will probably not be required.

Following discussions between GLAL and Monenco Limited about the on-site surface drainage of the site, it was recommended that the storm water outfall be located at an unnamed tributary to East Sixteen Mile Creek, near the bridge on Sixth Line Road and East Sixteen Mile Creek. The location is at Culvert #2 on Figure 24, and is shown on Figure 25.

4.3 SURFACE WATER USE

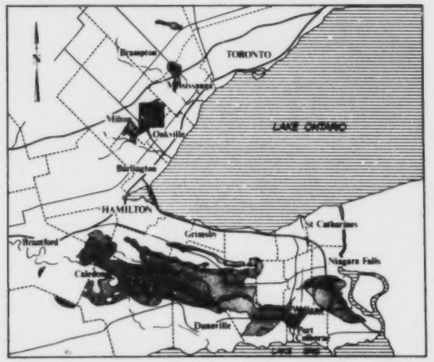
Watercourses whose uses could be effected by facility development and potential access routes are East Sixteen Mile Creek, Middle Sixteen Mile Creek (East Oakville Creek, Middle Oakville Creek) and several small tributaries. In addition, portions of Bronte Creek, Fourteen Mile Creek and the main branch of Sixteen Mile Creek (Oakville Creek) may be effected by the access route associated with the partially integrated option involving site LF-4N. The study area extends from the point of potential interference (e.g. access route crossing, projected



Phase 3B Acquisition Boundary — Site Vicinity Study Area Boundary

Key Map: PI-13 North

Lots 3 and 4; Concession VI; Town of Milton, formerly the Township of Trafalgar



1000 feet 0 1000
500 metres 0 500

EXISTING SURFACE WATER CONDITIONS, PHASE 4A

Local Surface Water Use

October 1985 **FIGURE 25**

OWMC Ontario Waste Management Corporation

Consultant: Gartner Lee Associates Limited

Legend:

- Municipal Intake
- Municipal Outfall
- Industrial Intake
- Industrial Outfall
- Recreation: B - beaches, S - swimming, Bt - boating, W - Winter Sports, P - Pond
- Rural Potable Supply
- Nonpotable Domestic Supply
- Livestock Watering (stream or pond)
- Irrigation - P71 M.O.E. Permit To Take Water
- Farm Pond Unspecified Use or Unused
- Stream Taking - Unspecified Use

storm water outfall location) downstream to Lake Ontario (Figure 2).

Of concern are the users of surface water downstream from the storm water outfall. Stream water was used at two locations for potable supplies and at two other locations for nonpotable domestic supplies.

4.3.1 LOCAL WATER USE

On a local scale, the walk-and-talk program and discussions with area residents identified several surface water uses on East Sixteen Mile Creek and its tributaries downstream from the access road crossings and the candidate site (Figure 25). This information is summarized in Table 8.*

A variety of potable and nonpotable domestic uses were noted downstream from the proposed storm water outfall location within the site vicinity, in addition to livestock, irrigation and recreational uses. Numerous farm ponds were identified on the site and in the site vicinity. These ponds were used for livestock watering and crop irrigation. During dry periods stream water may be taken to fill farm ponds and subsequently used for agricultural and domestic nonpotable purposes.

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* At the time of the walk-and-talk and other data collecting activities (summer and fall, 1984) the location of the storm water outfall had not been finalized. Consequently, local surface water use data were collected for all the streams downstream from the site. All of the data collected are shown on local surface water use figures of this report. For the purposes of comparative evaluation (GLAL, 1985a) only those uses of surface water downstream from the projected storm water outfall with the site vicinity (study area) were counted.

TABLE 8 SUMMARY OF LOCAL SURFACE WATER USE: PI-13N

Individuals Interviewed	Assessment Roll No.	Site (S) or Site Vicinity (SV)	Interview No., GLAL Field Visit No. (FV)	Surface Water Use Comments
J.C. Marshall	60-014-10	SV	210-2	stream crosses property, no ponds, no livestock
D. Jones	70-150-01	S	140-2 FV	2 ponds, 1 used for agricultural purposes, 1 used for livestock watering
C. Sweetman	70-136 70-135	SV	52-2 FV	fills farm pond from stream, used for irrigation & livestock watering
J.B. Marshall	60-013-20 90-037 60-013-10 60-014	SV SV SV SV	59-2	stream crosses property, farm pond used for livestock watering
A. Clancy	70-152-00	SV	235-1	no use indicated
A. Glinski	70-145	SV	128-1	stream crosses property, no use indicated
C. Austin	70-146	SV	237-1	stream crosses property, no use indicated
A. Endicott	70-070	SV	403G	stream on property
A. Jansen	70-073	SV	270	stream on property, 2 farm ponds, no use indicated
J. & C. McCann	100-08	SV	758	5 ponds identified (2 km from site), used for agricultural purposes
Mr. & Mrs. H. Japp	70-142-00	SV	234-1	no use indicated
A.F. McKee	70-072	SV	411-G	no use indicated
C. Marshall	40-118 70-074-01 70-075-01 70-144	SV S S S	1-2 FV	no use indicated farm pond identified during field visit, used for agricultural purposes
N. Biggar	70-073 70-151	SV SV	108-2	streams on both properties, no use indicated

(cont'd...)

TABLE 8 SUMMARY OF LOCAL SURFACE WATER USE: PI-13N

Individuals Interviewed	Assessment Roll No.	Site (S) or Site Vicinity (SV)	Interview No., GLAL Field Visit No. (FV)	Surface Water Use Comments
G. Jellaczye	70-139	SV	58-2	streams and ponds on property
	70-178	SV		used for agricultural purposes
G. Juengel	70-143	SV	6-1 FV	stream taking for domestic use and garden watering during dry periods
J. & S. Scott	70-001	SV	609	comment made that stream water is good for fish & livestock, livestock watering use assumed
S. Stadler	60-015	SV	256-2	farm pond used for agricultural purposes
J.C. Ford	70-076 90-053	SV	294	farm pond used for livestock operation
R.A. Davison	70-075-10	S	103-1	no use indicated
W.J. Rowe	70-147	SV	99-1	no use indicated
Mr. MacArthur	70-140	SV	FV	stream taking for potable water supply & domestic use
T. Sweetman	70-138	SV	FV	stream taking for potable water supply & domestic use
Mr. Doeherty	70-098	SV	FV	stream taking for domestic use
S. Carleton	70-176	SV	-	stream goes dry during dry periods,
M. McKinnon	60-039	SV	590	no use indicated
K. Merry	70-153 90-054-10	SV		no use indicated
B. Wilson (Ontario Land Corp.)	70-075-01 70-150-01 70-074-01	S S S	53-2	no use indicated
J.W.L. Monaghan (Land Fund Ltd.)	70-144	S	56-2	no use indicated

(cont'd)

TABLE 8 SUMMARY OF LOCAL SURFACE WATER USE: PI-13N

INDIVIDUALS INTERVIEWED	ASSESSMENT ROLL NO.	SITE (S) OR SITE VICINITY (SV)	INTERVIEW NO., GLAL FIELD VISIT NO. (FV)	SURFACE WATER USE COMMENTS
B. Kusiewicz	100-012	SV	629	stream taking for agricultural use
R. Lash	60-009	SV	46-2	stream, pond, no use indicated
F. Opstein	60-090-01 110-009 60-087-01 60-088 60-088-01	SV SV SV SV SV	265-2	pond & stream takings for agricultural use
G. Gillies	60-063-01 60-065 60-064 60-063 100-065	SV SV SV SV SV	217-2	pond & stream takings for livestock operation
A. Curtis	60-071	SV	39-2	pond & stream takings for agricultural use
G. Rayner	60-089	SV	418-6	pond & stream takings for livestock operation
Omagh Bible Camp	80-098	SV		stream taking for domestic use

A water intake for the Omagh Bible Camp was identified on East Sixteen Mile Creek near Fifth Line Road. Approximately 7,250 Litres per day (1600 Imp gal per day) are taken for domestic nonpotable use. Chlorinated stream water was reported to be used for washing and showers, with filtered and chlorinated stream water used for filling the swimming pool. In addition, surface water was used downstream from the stormwater outfall for livestock watering and other unspecified uses.

4.3.2 REGIONAL WATER USE

Major water uses downstream from candidate site PI-13N and its preferred access routes were identified on a regional scale by plotting MOE Permits To Take Water (PTTW), Figures 2 and 25. Permit information in the study area is summarized in Table 9. Many of the identified uses also pertain to candidate sites PI-1N and LF-4N.

Fourteen PTTW's were identified in the study area. Thirteen permits were issued for irrigation purposes such as agricultural crops, market gardening, tree nursery, and golf courses. One permit was issued to fill a pond used for aesthetic and fire fighting purposes. The majority (12) of the permits were situated on East and Middle Sixteen Mile Creeks and their tributaries near candidate site PI-13N. Of these, 11 permits were situated upstream from the site and downstream from access roads.

Two permits were identified on Sixteen Mile Creek for irrigation purposes. These permits were downstream from both candidate site PI-13N and candidate site PI-1N, and their access routes.

TABLE 9 SUMMARY PERMITS TO TAKE WATER: PI-13N

PERMIT NUMBER	STREAM	PURPOSE	MAXIMUM DAILY AMOUNT (m^3)
78-P-3048	Unnamed tributary to Middle Sixteen Mile Creek	Irrigation (crops)	477
64-P-250	Tributary East Sixteen Mile Creek	Irrigation	363
64-P-252	East Sixteen MileCreek	Irrigation (market garden crops)	237
72-P-280	East Sixteen Mile Creek	Aesthetic and Fire Fighting	--
77-P-3000	Middle Sixteen Mile Creek	Irrigation (tree nursery)	1,817
77-P-389	East Sixteen Mile Creek	Irrigation	352
69-P-347	Middle Sixteen Mile Creek	Irrigation	611
67-P-214	Middle Sixteen Mile Creek	Irrigation (golf course)	1,635
63-P-2617	Middle Sixteen Mile Creek	Irrigation (golf course)	981
66-P-385	East Sixteen Mile Creek	Irrigation	837
68-P-246	East Sixteen Mile Creek	Irrigation (market gardening)	296
78-P-3038	East Sixteen Mile Creek	Irrigation (crops)	1,635
67-P-113	Sixteen Mile Creek	Irrigation	131
74-P-3074	Sixteen Mile Creek	Irrigation (golf course)	--

N.B. East and Middle Sixteen Mile Creeks are also known locally as East and Middle Oakville Creeks, respectively.

An indication of "sensitive" surface water usage is provided by the DSWUI, presented in Table 10. Part A of this table shows the components of the index downstream from the storm water outfall. The DSWUI for PI-13N is 18.6. The values in Part B are based on the Access Road study area, i.e. from the access roads downstream to Lake Ontario. The access route DSWUIs range from 250.1 to 328.9.

TABLE 10 DOWNSTREAM WATER USE INDEX: PI-13N

STUDY AREA	LAND USE			DOWNSTREAM WATER USE INDEX
	WOODED	RECREATIONAL	RURAL	
A. Regional: Stormwater Outfall	15.3	2.5	0.8	18.6
B. Preferred Access Routes: To PI-13N:				
From Hwy 401	202.6	32.5	64.8	299.9
From QEW	172.9	27.0	50.2	250.1
PI-13N to Hwy 401 to LF-2N:	207.2	37.0	84.7	328.9
PI-13N to LF-4N:	196.7	33.0	47.1	276.8

4.4 PREFERRED ACCESS ROUTES

Stream Crossing Distances (SCD) for each of the preferred access routes to candidate site PI-13N, as well as between PI-13N and LF-2N and LF-4N, associated with the partially integrated siting options, are presented in Table 11.

TABLE 11 STREAM CROSSING DISTANCES FOR ACCESS ROUTES: PI-13N

PREFERRED ACCESS ROUTE	STREAM CROSSING DISTANCE (m)
To PI-13N:	
From Hwy 401	1,325
From QEW	5,170
PI-13N to Hwy 401 to LF-2N:	2,230
PI-13N to LF-4N:	2,185

4.5 RAIL ACCESS

Rail access to PI-13N crosses 4-7 streams, depending on the alignment chosen. There are three major crossings in the floodplain of Sixteen Mile Creek.

4.6 SUMMARY OF FINDINGS

Flood Susceptibility

- Site PI-13N is characterized by good topographic relief and is generally well drained.
- No part of the site is located on designated floodplain land.
- There is a small upstream area contributing runoff to the site.

- Outlet culverts with inadequate capacity are not likely to cause significant flooding of the site under existing conditions.

- It appears that outlet swales have sufficient slope such that runoff can be conveyed away from the site without a backwater effect.

Drainage Improvements

- Upstream area draining through the proposed location of the facility is expected to be minor. Surface runoff can be intercepted with perimeter ditching and routed around the site.

- It is anticipated that neither downstream channelization nor structure replacement nor storm water management facilities will be necessary, since little increase in post-development flows is expected.

- Stormwater management is required to determine water quality prior to discharge to the local stream system.

- The recommended stormwater outfall location is at Culvert #2 into East Sixteen Mile Creek.

Water Use

- Local water use is considered to be high.

- Two locations with potable and two other locations with nonpotable domestic water supplies were noted downstream from the stormwater outfall.

- Other uses identified include livestock watering and irrigation.

- Fourteen MOE PTTW were identified.

- No municipal water supply intakes were identified.

- The DSWUI is 18.6.

Access Routes

- Some major stream crossings (e.g. Sixteen Mile Creek) were identified.

- SCDs range from 1,325 to 5,170.

- The access road DSWUIs range from 250.1 to 328.9.

Rail Access

- Rail access study area contains one major floodplain (Sixteen Mile Creek).

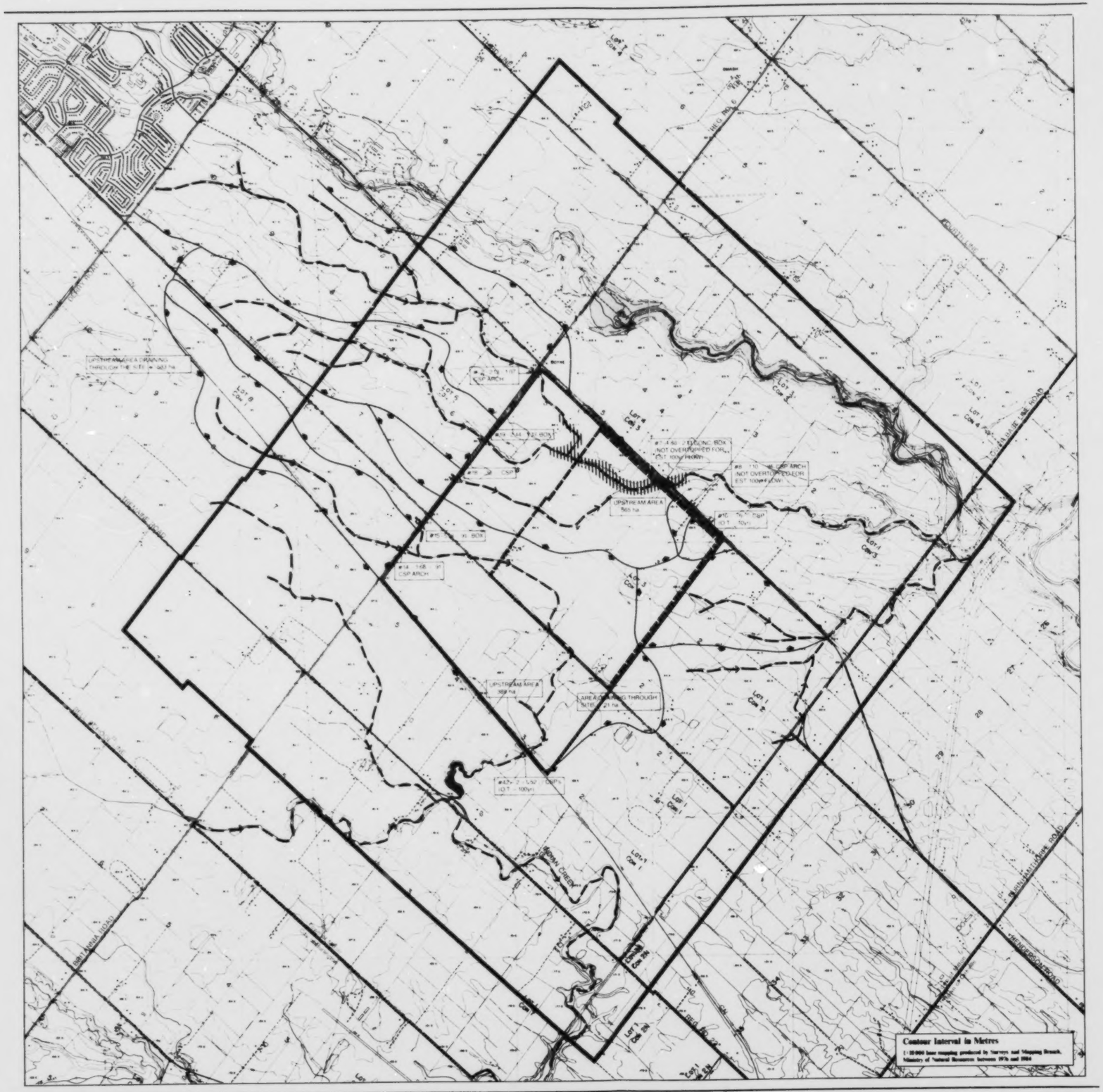
5.0 CANDIDATE SITE PI-1N SURFACE WATER CONSIDERATIONS

5.1 FLOOD SUSCEPTIBILITY

This site is characterized by moderate topographic relief and appears to be fairly well drained. The eastern half of the site is drained by a well defined swale which conveys runoff in a southeast direction, beneath Hwy 25 (Bronte Road, site boundary) and eventually to Sixteen Mile Creek. The western half of the site is drained by a poorly defined swale which conveys runoff south, and then east through the site, beneath the CN Railway Line, and eventually to Bronte Creek. The Bronte Creek/Sixteen Mile Creek watershed divide runs in an approximate northeast-southwest direction through the middle of the site, Figure 26.

No floodplain mapping has been undertaken in the vicinity of this site. Consequently no part of it has been designated as floodplain land. If this site remains under consideration in Phase 4B, the floodplains associated with both the Bronte Creek and Sixteen Mile Creek tributaries which drain through the site should be accurately determined using detailed hydrologic and hydraulic analyses.

Four outlet culverts were identified during field visits to this site. The drainage areas, culvert sizes and flow estimates at each outlet culvert are shown in Table 12. The culvert numbers are referenced to Figure 26. Comparisons of flow estimates with culvert capacities indicates that two of the four roadways would be overtopped by the estimated 100 year return



OWMC Ontario Waste Management Corporation

Consultant:
DILLON
Gartner Lee Associates Limited

Legend:

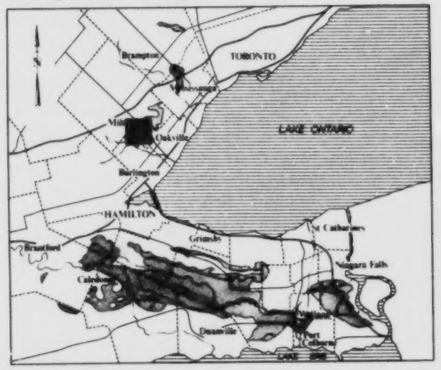
- Regional Storm Floodplain
- Flood-Prone Area
- Channel or Swale
- Watershed Divide
- Culvert or Bridge Crossing
- (O.T. - 5yr) Crossing Overtopped For Estimated Flow (Inlet Control)
- CSP Corrugated Steel Pipe
- #18 - 36 : CSP Culvert Identification Number, Size (m) and Type

Note: All Culvert Dimensions in Meters

- Proposed Acquisition Boundary
- Phase 3B Acquisition Boundary
- Site Vicinity Study Area Boundary

Key Map: PI-1 North

Lots 3, 4 and 5; Concession 11; Town of Milton; Parts of Lots 3, 4 and 5; Concession 1; Town of Milton, formerly in the Township of Trafalgar



1000 feet 0 1000
500 metres 0 500

Existing Surface Water Conditions
PHASE 4A

Surface Drainage: PI-1N

October 1985

FIGURE 26

TABLE 12 FLOOD SUSCEPTIBILITY DATA: PI-1N

No. of Outlets	Outlet Ref. # (see Fig. 26)	Drainage Area to Outlet (ha)	Size of Outlet (m)	Capacity of Outlet at: Top of Road (m^3/s)	Capacity of Outlet at: Obvert (m^3/s)	Flow Estimates (m^3/s) Q5*	Q10*	Q50*	Q100*	Approx. Slopes of Outlet Swales (%)
4	7	565	4.9 x 2.1 Box	39.4	20.4	8.9	12.1	16.1	18.7	0.7
	8	4	1.1 x 0.9 Arch	2.2	1.0	0.7	0.8	1.0	1.5	1.5
	10	7	0.8 Ø CSP	1.3	0.6	1.1	1.3	1.6	2.0	1.5
	42	389	2, 1.5 Ø CSP **	12.5	6.2	6.1	8.2	11.0	12.9	0.2

* 5, 10, 50, 100 refers to the length (years) of the return period of the storm under consideration.

** CSP=Corrugated Steel Pipe

period storm flow. Overtopping of roadways at outlet culverts indicates a potential for the backing up of flood waters onto the site. This can be expected at Culvert #42 where the railway embankment creates a significant barrier to flow once the capacity of the twin 1.5 m diameter outlet culverts is exceeded. The overtopping of Culvert #10 as a result of inadequate capacity is not significant since it only drains a small depression area in the southeast corner of the site.

In general, the 100 year return period storm peak flow estimates at the significant outlet Culverts (#7 and #42) are relatively high (12.9 - 18.7 m^3/s) due to the large areas upstream from the culverts. These culverts (#7 and #42) have catchments of 560 ha and 390 ha, respectively. These large areas suggest that substantial swales may be required to convey runoff through, and off the site without flooding it. From preliminary estimates of outlet swale slopes (Sixteen Mile Creek tributary = 0.7%, Bronte Creek tributary = 0.2%) and from field observations, it appears that site flooding may occur along the Bronte Creek tributary but is less likely along the Sixteen Mile Creek tributary. However, the extent of each floodplain should be accurately determined under Phase 4B if this site is considered further.

5.2 DRAINAGE IMPROVEMENT CONSIDERATIONS

For Site PI-1N, minor drainage improvements (channelization and re-routing of on-site swales) will be necessary. Small areas of some drainage basins will need to be diverted to a common outlet. Local ditching and channelization in the vicinity of the facility would be constructed to minimize the impact on local drainage. Finally, it is expected that the existing conditions

of peak flows will not be significantly increased after the site is developed, and therefore no downstream channel or structure improvements (beyond those needed to eliminate existing site flooding) would be required.

Interviews with landowners indicate that none of the site is tile-drained and therefore tile drain removal is not likely to be required.

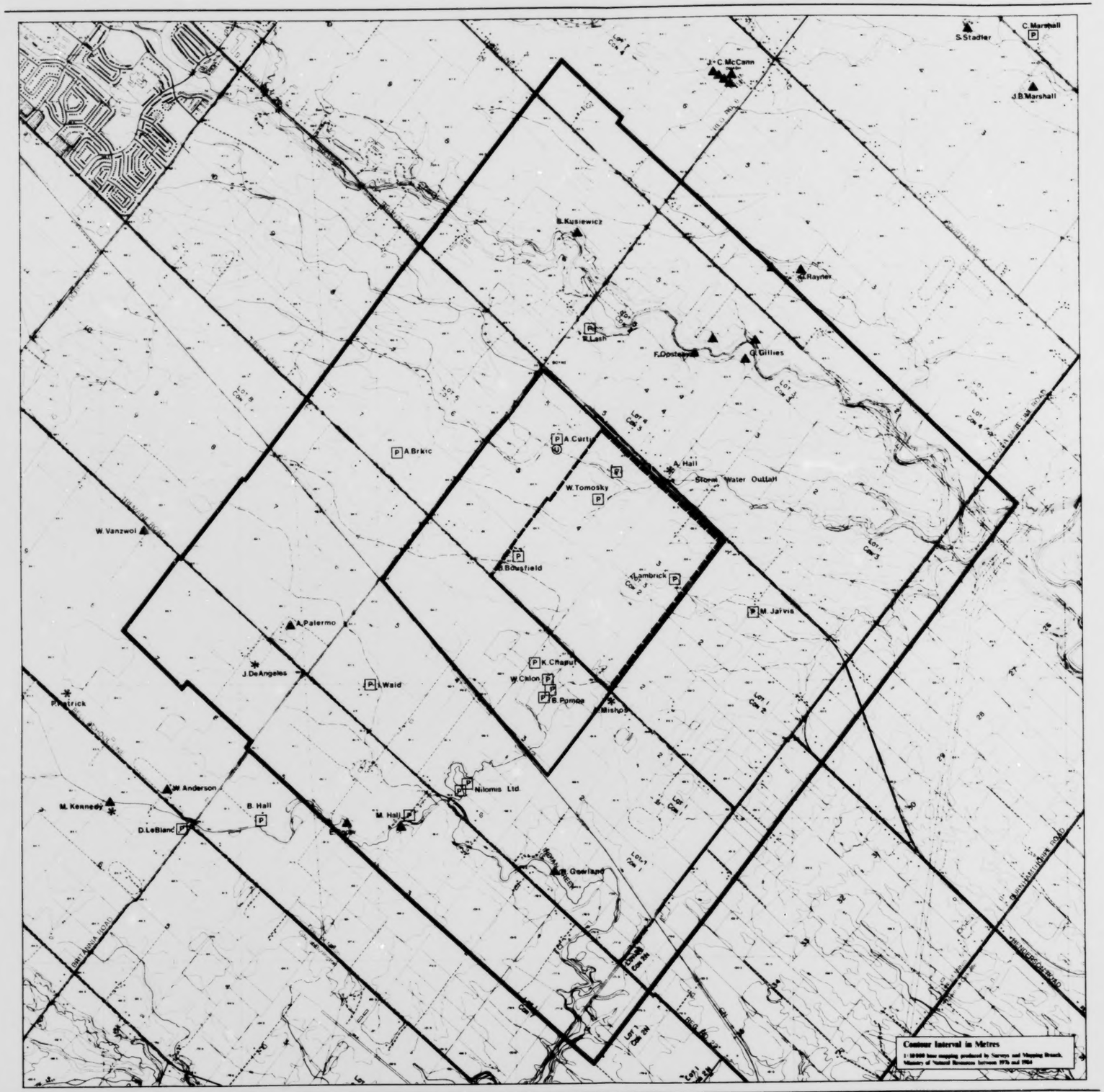
Following discussions between GLAL and Monenco Limited about the on-site surface drainage of the site it was recommended that the projected storm water outfall be located at Culvert #7, on Hwy 25. This location is shown on Figures 26 and 27. Storm water would flow from Culvert #7 to an unnamed tributary of Sixteen Mile Creek.

5.3 SURFACE WATER USE

Watercourses whose users could be effected by facility development and potential access routes are Indian Creek, Bronte Creek, Fourteen Mile Creek, Sixteen Mile Creek and Middle Sixteen Mile Creek. As well there are several smaller tributaries crossed by alternative access roads. The study area extends from the point of potential interference (e.g. access route crossing, and storm water outfall) downstream to Lake Ontario (Figure 2).

5.3.1 LOCAL WATER USE

Water use information at a local scale was obtained through the walk-and-talk questionnaires. This information is depicted



OWMC Ontario Waste Management Corporation

Consultant: Gartner Lee Associates Limited

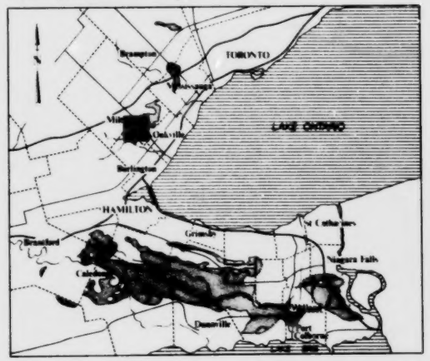
Legend:

- Municipal Intake
- Municipal Outfall
- Industrial Intake
- Industrial Outfall
- B Recreation : B - beaches, S - swimming, Bt - boating, W - Winter Sports, P - Pond
- Rural Potable Supply
- Nonpotable Domestic Supply
- Livestock Watering (stream or pond)
- Irrigation - P.T.T.W. M.O.E. Permit To Take Water
- P Farm Pond Unspecified Use or Unused
- U Stream Taking - Unspecified Use

Proposed Acquisition Boundary
Phase 3B Acquisition Boundary
Site Vicinity Study Area Boundary

Key Map: PI-1 North

Lots 3, 4 and 5; Concession II; Town of Milton; Parts of Lots 3, 4 and 5; Concession I; Town of Milton, formerly in the Township of Trafalgar



1000 feet 0 1000
500 metres 0 500

EXISTING SURFACE WATER CONDITIONS, PHASE 4A

Local Surface Water Use

October 1985 **FIGURE 27**

on site and site vicinity maps (Figure 10) and summarized in Table 13.*

The walk-and-talk program did not identify any locations where surface water was used for potable or nonpotable domestic supplies, downstream from the preferred stormwater outfall location within the site vicinity. Potable supplies appear to be typically drawn from either drilled wells or dug/bored wells (Site Selection Process, Phase 4A: Selection of a Preferred Site(s) - Geologic, Hydrogeologic and Geotechnical Considerations; GLAL, 1985b). Wells also appear to be the major source of livestock water.

At numerous locations within the site (11) and site vicinity (nine) pond or streamwater is used, but for unspecified purposes. These uses are probably agricultural e.g. livestock watering. At 11 locations within the site vicinity surface water is used for livestock watering, with a further three locations using surface water for irrigation. However, only one use of surface water (irrigation) was noted within the site vicinity downstream from the projected stormwater outfall.

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* At the time of the walk-and-talk and other data collecting activities (summer and fall, 1984) the location of the stormwater outfall had not been finalized. Consequently, local surface water use data were collected for all the streams downstream from the site. All of the data collected are shown on local surface water use figures of this report. For the purposes of comparative evaluation (GLAL, 1985a), only those uses of surface water downstream from the projected storm water outfall with the site vicinity (study area) were counted.

TABLE 13 SUMMARY OF LOCAL SURFACE WATER USE: PI-1N

Individuals Interviewed	Assessment Roll No.	Site (S) or Site Vicinity (SV)	Interview No., GLAL Field Visit No. (FV)	Surface Water Use Comments
J. Sum & B. Kusiewicz	100-012	SV	629	stream taking for agricultural use
Mrs. F. Vertulia	60-066	SV	124-1	no stream or pond on property
B. Pompa	60-027	S	51-2	2 ponds & stream no use indicated
W. Tomosky	60-067	S	60-2	2 ponds (1 is spring fed)& stream, no use indicated
Mr. Da Silva	60-100	SV	469-G	no stream or pond on property
J. Rada	60-070	S	12-1	no stream or pond on property
F. Jelinek	60-059	S	57-1	no stream or pond on property
M. Dolby	60-011	SV	27-1	no stream or pond on property
C. Ford	60-025	S	22-1	no stream or pond on property (formerly swamp land)
A. Hall	60-062	SV	86-1a	stream used for irrigation, many springs in the vicinity
Mr. A. Mishos	60-023	SV	18-1a	stream taking to irrigate garden
Nilomis Ltd.	60-98 60-101 307-051 307-052-10	SV SV SV SV	272	2 ponds, no use identified
F. Opstein	60-090-01 110-009 60-087-01 60-088 60-088-01	SV SV SV SV SV	265-2	pond & stream takings for agricultural use
J. Templeman	60-099	SV	459-G	no use indicated

(cont'd)

TABLE 13 SUMMARY OF LOCAL SURFACE WATER USE: PI-1N (continued)

Individuals Interviewed	Assessment Roll No.	Site (S) or Site Vicinity (SV)	Interview No., GLAL Field Visit No. (FV)	Surface Water Use Comments
P.J. Lambrick	60-059-01 60-056	S SV	292	pond (springs near bush), no use indicated
W. Chlon	60-028	S	238-2	pond, no use indicated
I.R. Waid	60-104-01	SV	448-G	pond on property, no use indicated
R. Lash	60-009	SV	46-2	stream, pond no use indicated
W.T. Martin	60-032	S	21-2	no use indicated
A. Brkic	110-009	SV	35-2	pond on property, no use indicated
Mr. Salo (Getex Pharmaceuticals)	60-034	S	37-2	spring fed waterway, no use indicated
P. Marahgoni	60-031	S	40-2	no use indicated
Kip Chapu	60-030	S	15-2	pond, no use indicated
Mr. Vitetta & Mrs. Rita Leone	60-068	SV	80-1A	no use indicated
Mrs. B. Ketelaars	60-023-10	S	222-1	no use indicated
D. DePaoli	60-069	S	14-2	small stream on property no use indicated
G. Marshall	60-102	SV	19-2	no use indicated
Mrs. A. Curtis	60-071	S	39-2 44-2	pond & stream takings for agricultural use
H. Gowland	60-097 60-094-10	SV	45-2	stream takings for agricultural use
G. Gillies	60-063-01 60-065 60-064 60-063 100-065	S SV SV SV SV	217-2	pond & stream takings for livestock operation
J. Goddard	110-029	SV	627	creek, no use indicated
Mr. Hagemans	100-010	SV	419-G	no use indicated
G. Rayner	60-089	SV	418-G	pond & stream water takings for livestock operation

(cont'd)

TABLE 13 SUMMARY OF LOCAL SURFACE WATER USE: PI-1N (continued)

Individuals Interviewed	Assessment Roll No.	Site (S) or Site Vicinity (SV)	Interview No., GLAL Field Visit No. (FV)	Surface Water Use Comments
B. Bousfield	60-032 60-031	S S	126-2	stream & pond, no use indicated
M. Jarvis	60-89	SV	121-2	pond, no use indicated
G. Vanderheyden	60-096	SV	440-G	no use indicated
L. Moore	60-024	S	781	no use indicated
H.K. Jarvis	60-058	SV	2-87 IEC#2	no use indicated
K. Wettlanfer	60-029 60-069 60-020 60-061 60-019 60-057-01 60-056-01 110-012	S S SV SV SV SV SV SV	293	no use indicated
M/M S. Dolby	100-062	SV	414-G	no use indicated
J. & C. McCann	100-08	SV	758	5 ponds for agricultural use
B. Hall	306-174	SV	78-2	pond & stream on property
A. Palermo	110-068	SV	123-1	pond taking for livestock operation
E. Snow	306-083	SV	143-2	stream taking for livestock operation
J. deAngeles	306-085-10	SV	37-1a	irrigation from pond
M. Hall	306-081	SV	486-G	pond on property, stream taking for livestock

(cont'd)

TABLE 13 SUMMARY OF LOCAL SURFACE WATER USE: PI-1N (continued)

INDIVIDUALS INTERVIEWED	ASSESSMENT ROLL NO.	SITE (S) OR SITE VICINITY (SV)	INTERVIEW NO., GLAL FIELD NO. (FV)	SURFACE WATER USE COMMENTS
H. Vanzwol	306-087	SV	125-2	pond for unspecified agricultural use, pond for livestock operation
M. Kennedy	306-021	SV	84-1a	stream for horse operation & domestic use
P. Patrick	306-025	SV	47-1	pond for domestic garden use
W. Anderson	306-019	SV	5-2	pond for livestock operation
D. LeBlanc	306-170	SV	49-2	pond for unspecified use
C. Marshall	40-118 70-074-01 70-075-01 70-144	SV SV SV	1-2 FV	farm pond identified during field visit, used for agricultural purposes
J.B. Marshall	60-013-20 90-037 60-013-10 60-014	SV SV SV SV	59-2	stream crosses property farm pond used for livestock watering
S. Stadler	60-015	SV	256-2	farm pond used for agricultural purposes

5.3.2 REGIONAL WATER USE

Major water uses downstream from candidate site PI-1N and its access routes were identified on a regional scale by plotting MOE Permits To Take Water (PTTW) (Figures 2 and 27). Permit information in the downstream study areas is summarized in Table 14. Many of the uses identified also pertain to candidate sites PI-13N and LF-4N.

A total of 12 PTTW were identified in the study area. Ten permits were issued for irrigation purposes such as agricultural crops, market gardening, tree nursery, and golf courses adjacent to the Sixteen Mile Creek system. Two permits were issued for recreational and irrigation purposes on Bronte Creek.

An indication of sensitive surface water usage is given by the DSWUI, presented in Table 15. Part A of this Table shows the components of the DSWUI downstream from the preferred storm water outfall location. The DSWUI for PI-1N is 14.5. Part B of Table 15 shows the DSWUIs for the preferred access routes to PI-1N, and between PI-1N and LF-2N. Part C shows the DSWUIs for the alternative routes between PI-1N and LF-4N. The DSWUIs for the access routes range from 87.4 to 309. The study area for this information consists of streams between the access routes and Lake Ontario.

5.4 ACCESS ROUTES

Stream Crossing Distances (SCD) for each of the preferred access routes to candidate site PI-1N and from PI-1N to LF-2N, and the alternative access routes between PI-1N and LF-4N, associated with the partially integrated siting options, are presented in Table 16.

TABLE 14 SUMMARY OF PERMITS TO TAKE WATER: PI-1N

PERMIT NUMBER	STREAM	PURPOSE	MAXIMUM DAILY AMOUNT (m^3)
77-P-3000	Middle Sixteen Mile Creek	Irrigation (tree nursery)	1,817
77-P-389	Middle Sixteen Mile Creek	Irrigation	352
69-P-347	Middle Sixteen Mile Creek	Irrigation	611
67-P-214	Middle Sixteen Mile Creek	Irrigation (golf course)	1,635
63-P-2617	Middle Sixteen Mile Creek	Irrigation (golf course)	981
66-P-385	East Sixteen Mile Creek	Irrigation	837
68-P-246	East Sixteen Mile Creek	Irrigation (market gardening)	296
78-P-3038	East Sixteen Mile Creek	Irrigation (crops)	1,635
67-P-113	Sixteen Mile Creek	Irrigation	131
74-P-3074	Sixteen Mile Creek	Irrigation (golf course)	--
81-P-3026	Bronte Creek	Recreation	1,316
65-P-438	Bronte Creek	Irrigation (golf course)	341

N.B. Sixteen Mile Creek is also known locally as Oakville Creek.

TABLE 15 DOWNSTREAM WATER USE INDEX: PI-1N

STUDY AREA	LAND USE			DOWNSTREAM WATER USE INDEX
	WOODED	RECREATIONAL	RURAL	
A. Regional: Stormwater Discharge	10.4	2.5	1.6	14.5
B. Preferred Access Routes: To PI-1N:				
From Hwy 401	199.8	33.5	75.7	309.0
From QEW	47.1	9.8	36.4	93.3
PI-1N to Hwy 401 to LF-2N:	204.4	38.0	95.6	338.0
C. Alternative Access Routes: PI-1N to LF-4N:				
Option 1	52.8	4.0	30.6	87.4
Option 2	60.2	8.0	28.4	96.6

TABLE 16 STREAM CROSSING DISTANCES FOR ACCESS ROUTES: PI-1N

ACCESS ROUTE	STREAM CROSSING DISTANCE (m)
A. Preferred Access Routes: To PI-1N:	
From Hwy 401	1,710
From QEW	3,485
PI-1N to Hwy 401 to LF-2N:	2,615
B. Alternative Access Routes: PI-1N to LF-4N:	
Option 1	400
Option 2	500

*The numbers refer to alternative access routes listed in Section 1.6.4.

5.5 RAIL ACCESS

Rail access to PI-1N crosses 0 or 1 minor stream, depending on the alignment chosen. No floodplains or wetlands are crossed.

5.6 SUMMARY OF FINDINGS

Flood Susceptibility

- Site PI-1N is characterized by moderate topographic relief and appears to be fairly well drained.
- No part of the site is located on designated floodplain land.
- There is a significant upstream drainage area which contributes runoff to the site (604 ha).
- Inadequate culvert capacity at Culvert #42 may cause local flooding upstream from the western site boundary (railway line).
- It appears that the main outlet swale, east of the site, has sufficient slope to convey runoff away from the site without a significant backwater effect. However, the western outlet swale has a milder gradient and may potentially cause site flooding.

Drainage improvements

- The upstream area draining through the site is substantial and may require that drainage through swales on-site and downstream from Culvert #42 be upgraded. The degree of upgrading required will depend on the final siting of the facility as determined in Phase 4B.

- No significant increase in peak flow rates is anticipated after the site is developed. Therefore no additional downstream improvements will be required.

- The preferred location of storm water outfall is at Culvert #7, flowing into Sixteen Mile Creek.

Water Use

- Local water use is considered to be moderate.

- No surface water is taken for potable supplies or domestic use.

- Stream water is taken at only one location downstream from the storm water outfall (for irrigation).

- Twelve MOE PTTW were identified on a regional scale, mainly for irrigation.

- The DSWUI is 14.5.

Access Routes

- There are some major stream crossings (e.g. Sixteen Mile Creek, Bronte Creek).

- Access routes cross many streams. The potential for interference with downstream sensitive water uses is considered significant in the event of an in-transit spill.

- Stream Crossing Distances range from 400 to 3485 m.

- The access road DSWUIs range from 87.4 to 338.0.

Rail Access

- 0 or 1 minor streams crossed.

6.0 CANDIDATE SITE LF-4N SURFACE WATER CONSIDERATIONS

6.1 FLOOD SUSCEPTIBILITY

This site is characterized by fairly flat relief, sloping gently from elevation 186 m a.s.l. in the northeast to 182 m a.s.l. in the southwest corner. It is only moderately well drained, with a permanent wetland near the southern boundary of the site. Other wet pockets may exist during wet weather because of the flat topography.

No significant watercourses exist on-site. Two minor swales convey overland flow from the site beneath Britannia Road to the south, and two swales convey runoff from the remaining portion of the site beneath Bell School Line to the west.

All four swales eventually flow into Indian Creek, which comprises part of the Bronte Creek watershed. The floodplain of Indian Creek has been mapped by the Halton Region Conservation Authority as shown on Figure 28. Approximately 2 ha within the extreme northwest and southwest corners of this site are located within the Indian Creek Regional Storm Floodplain and hence these areas are designated floodplain lands. The main branch of Indian Creek (which flows to the north, west and south of the site) is the only major watercourse in the vicinity of the site which could cause flooding. A minor tributary of Indian Creek exists to the east of the site but it does not likely pose a flood threat due to its small drainage area.

LIMESTONE CREEK
CREEK
BRONTE

OWMC Ontario Waste Management Corporation

Consultant:

DILLON

Gartner Lee Associates Limited

Legend:

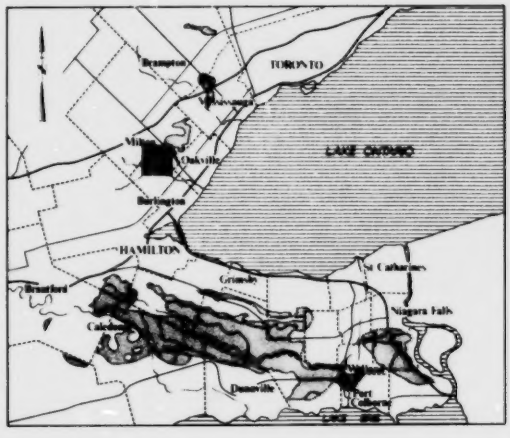
- Regional Storm Floodplain
- Swamp or Low Lying Area
- Channel or Swale
- Watershed Divide
- Culvert or Bridge Crossing
- (O.T. - 5yr) Crossing Overtopped For Estimated Flow (Inlet Control)
- CSP Corrugated Steel Pipe
- Culvert Identification Number, Size (m) and Type

Note: All Culvert Dimensions in Meters

Phase 3B Acquisition Boundary — Site Vicinity Study Area Boundary

Key Map: LF-4 North

Lots 6 and 7; Concession VII; Town of Milton, formerly in the Township of Nelson



1000 feet 0 1000
500 metres 0 500

Existing Surface Water Conditions
PHASE 4A

Surface Drainage: LF-4N

October 1985 FIGURE 28

Five outlet culverts were identified during field visits to the site, as shown on Figure 28. The drainage areas, culvert sizes and flow estimates at each outlet culvert are shown in Table 17. The culvert numbers in Column #2 are referenced to Figure 28. Comparison of flow estimates with culvert capacities indicates that all of the roadways except at Culvert #1, will be overtopped by the 5 year return period storm flow. The roadway at Culvert #1 (Indian Creek at Britannia Road) could be overtopped by the estimated 10 year return period storm flow. Because the site is so flat, it is likely that the overtopping of roads at culverts under existing conditions results in frequent on-site flooding. However, more topographic data and hydraulic analyses are required to accurately assess the effect on site flooding of these inadequate outlet culverts. If this site is selected for further study under Phase 4B, then this more detailed analysis should be undertaken.

In general, estimated 100 year return period peak flows are very low at all outlets (3.4 - 5.1 m^3/s) except Culvert #1 (74 m^3/s). This is because Culvert #1, located adjacent to the extreme southern corner of the site, must convey runoff from the large (2,200 ha) Indian Creek basin, upstream from the site. The remaining outlets only drain local runoff from the site and minor adjacent areas.

Slopes of existing outlet swales are low to moderate, ranging from 0.2% to 0.3% downstream from the site. Some of the swales have been almost obliterated by ploughing and agricultural practices and may require upgrading to ensure that site flooding does not result from insufficient downstream capacity. Site flooding in Indian Creek is restricted

TABLE 17 FLOOD SUSCEPTIBILITY DATA: LF-4N

No. of Outlets	Outlet Ref. # (see Fig. 28)	Drainage Area to Outlet (ha)	Size of Outlet (m)	Capacity of Outlet at: Top of Road (m^3/s)	Capacity of Outlet at: Obvert (m^3/s)	Flow Estimates (m^3/s) Q5*	Q10*	Q50*	Q100 *	Approx. Slopes of Outlet Swales (%)
5	1	2200	8.5 x 2.1 Box	45.3	38.1	37.8	48.0	64.2	73.6	0.16
	2	4	0.6 Ø CSP**	0.57	0.34	2.7	3.1	4.2	4.6	0.23
	16	3	0.46 Ø CSP	0.2	0.19	1.9	2.2	3.1	3.4	0.29
	17	5	0.46 Ø CSP	0.2	0.19	2.9	3.3	4.6	5.1	0.29
	21	6	0.6 Ø CSP	0.74	0.34	2.3	2.7	3.4	3.9	0.23

* 5, 10, 50, 100 refer to the length (in years) of the return period of the storm under consideration
** Corrugated Steel Pipe

to approximately 2 ha in the extreme southwest and northwest corners of the site. To avoid major alterations to this watercourse, the waste disposal facilities (landfill and plant) could be sited to the east, away from the potential flood area adjacent to Bell School Line.

6.2 DRAINAGE IMPROVEMENT CONSIDERATIONS

As with all of the landfill sites, the existing swales and drainage patterns will be eliminated due to the landfill mound and associated construction. The on-site drainage system will be improved by constructing perimeter ditches near the site boundaries.

If this candidate site is developed as a landfill, on-site slopes will be increased considerably over the existing, relatively mild gradient. This will provide the potential for significant peak flow rate increases downstream. To mitigate the adverse impacts associated with increased flows, from the possible uncontrolled release of storm runoff, some downstream channel and culvert improvements can be expected, If existing outlets are maintained, approximately 1,400 m of channelization would be required downstream from Culvert #16. Also, five outlet culverts would require replacement. However, the routing of all site runoff to Culvert #1 via perimeter ditching appears feasible. It could eliminate the need for downstream channel improvements, and would only require that two structures be replaced. The impact of routing runoff from the developed site to Indian Creek is expected to be insignificant (in terms of increasing peak flows) due to the relatively large size of the Indian Creek basin.

If necessary, control of post-development peak flows to pre-development levels can be accomplished with on-site detention storage. The required storage volume to control the 100 year return storm runoff is approximately 45,000 m^3.

Interviews with landowners indicate that none of the site is tile-drained and therefore, tile drain removal may not be required.

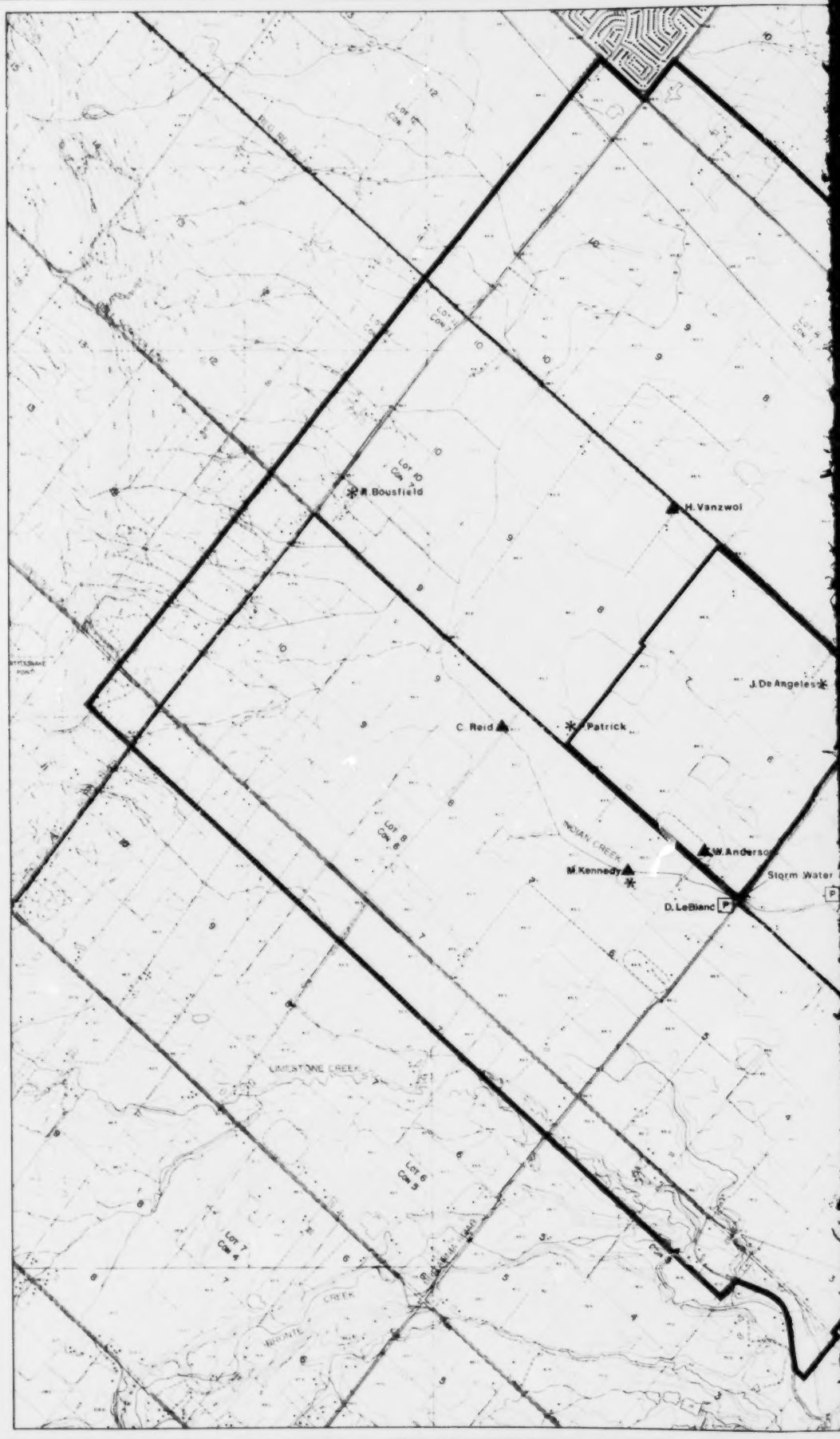
Following discussions among GLAL and Monenco Limited about the on-site surface drainage of the site, it was recommended that the projected storm water outfall be located at the southern corner of the site at Indian Creek. This location is shown in Figures 28 and 29.

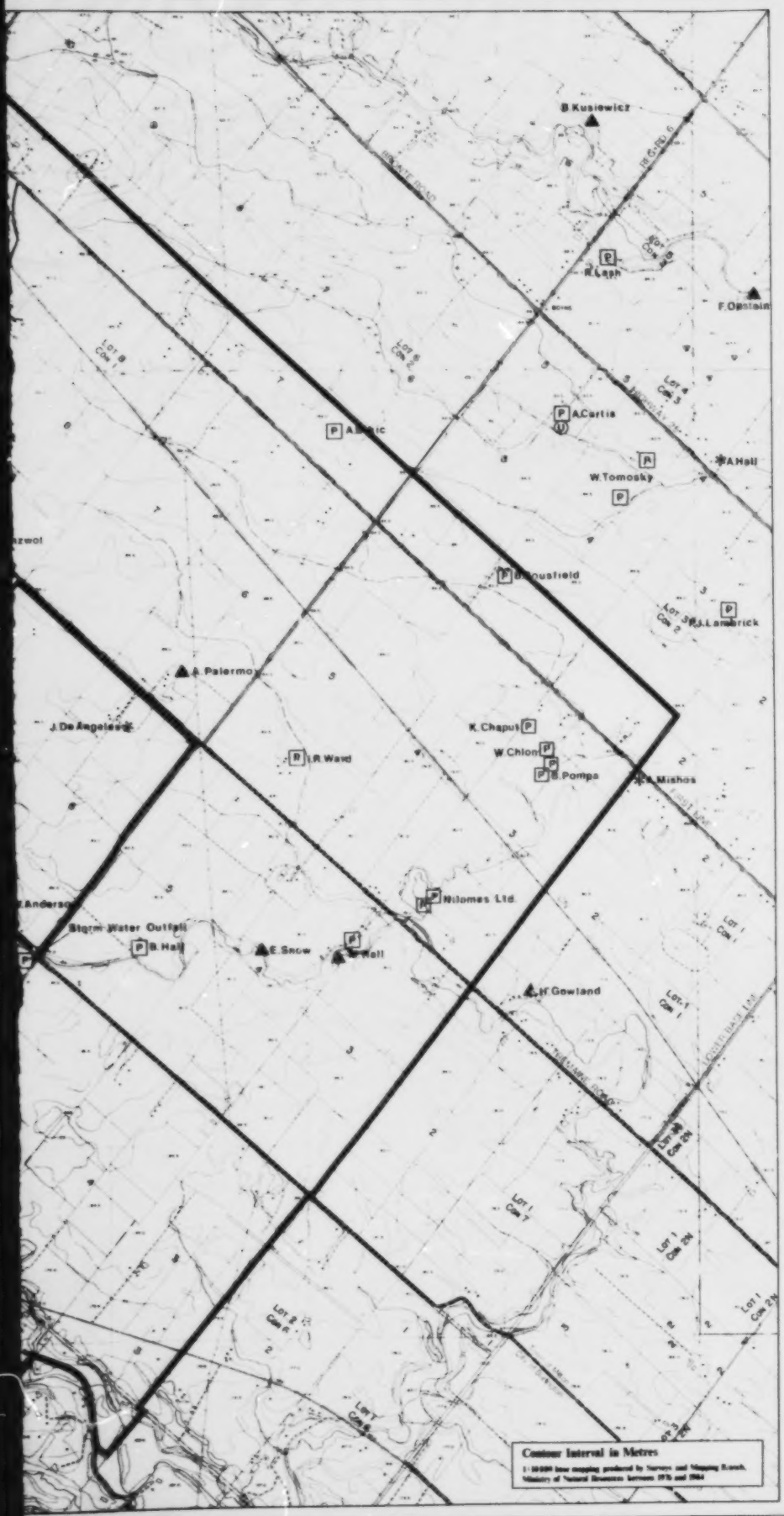
6.3 SURFACE WATER USE

The study area for identifying surface water uses that may potentially be effected by the development of site LF-4N and its alternative access routes consists of portions of Bronte Creek, Fourteen Mile Creek, Sixteen Mile Creek and several smaller tributaries to these creeks. The study area extended from the point of potential input on surface waters (e.g. site boundary or access route crossing) downstream to Lake Ontario. The study area is shown in Figure 2.

6.3.1 LOCAL WATER USE

Water use information at a local scale was obtained through the walk-and-talk questionnaires and site tours with local residents. This information is provided on the site and


R.Bousfield
H.Vanzwol
J.De Angelis
C. Reid
Patrick
W.Anderson
M.Kennedy
Storm Water
D.LeBlanc
INDIAN CREEK
LIMESTONE CREEK
Lot 10 Con 2
Lot 9 Con 1
Lot 8 Con 6
Lot 6 Con 5
Lot 7 Con 4



OWMC Ontario Waste Management Corporation

Consultant: Gartner Lee Associates Limited

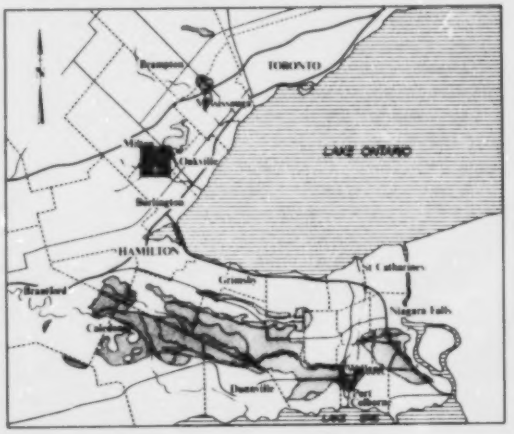
Legend:

- Municipal Intake
- Municipal Outfall
- Industrial Intake
- Industrial Outfall
- Recreation: B - beaches, S - swimming, Bt - boating, W - Winter Sports, P - Pond
- Rural Potable Supply
- Nonpotable Domestic Supply
- Livestock Watering (stream or pond)
- Irrigation - P71 M.O.E. Permit To Take Water
- Farm Pond Unspecified Use or Unused
- Stream Taking - Unspecified Use

Phase 3B Acquisition Boundary — Site Vicinity Study Area Boundary

Key Map: LF-4 North

Lots 6 and 7; Concession VII; Town of Milton, formerly in the Township of Nelson



1000 feet 0 1000
500 metres 0 500

EXISTING SURFACE WATER CONDITIONS, PHASE 4A

Local Surface Water Use

October 1985 FIGURE 29

site vicinity map (Figure 29) and summarized in Table 18.*

Surface water is taken from Indian Creek at several places for livestock watering purposes. Generally, domestic water supplies are drawn from a combination of drilled and/or dug/bored wells, supplemented by cisterns (Site Selection Process, Phase 4A: Selection of a Preferred Site(s) - Geologic Hydrogeologic and Geotechnical Considerations; GLAL, 1985b).

No use of surface waters was identified for potable purposes downstream from the stormwater outfall within the site vicinity. On the basis of the information collected, the potential for interference with surface water uses in the immediate site area appears to be low.

6.3.2 REGIONAL WATER USE

Major water uses downstream from candidate site LF-4N and its access routes were identified on a regional scale by plotting Permits To Take Water (PTTW) issued by MOE (see Figures 2 and 29). PTTW information in the downstream study areas is summarized in Table 19. Many of the uses identified also pertain to candidate sites PI-1N and PI-13N.

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* At the time of the walk-and-talk and other data collecting activities (summer and fall, 1984) the location of the storm water outfall had not been finalized. Consequently, local surface water use data were collected for all the streams downstream from the site. All of the data collected are shown on local surface water use figures of this report. For the purposes of comparative evaluation (GLAL, 1985a), only those uses of surface water downstream from the projected storm water outfall with the site vicinity (study area) were counted.

TABLE 18 SUMMARY OF LOCAL SURFACE WATER USE: LF-4N

Individuals Interviewed	Assessment Roll No.	Site (S) or Site Vicinity (SV)	Interview No., GLAL Field Visit No. (FV)	Surface Water Use Comments
J. Johnson	306-026-00	SV	31-1	no use indicated
M/M Smith	306-022	S	296	no use indicated
H.J. Reid	306-023	SV	516	stream on property, no use indicated
John Micallaf for R.F. Kowal	306-085	S	504	no use indicated
J. Snyder	60-103	SV	760	no use indicated
B. Pompa	60-027	SV	51-2	2 ponds & stream on property
D. Katz	110-068	SV	122-1	stream on property, no use indicated
B. Bousfield	60-031 60-032	SV	126-2	stream & pond on property
J. Stutt	110-07 110-073 110-023 110-006	SV SV SV SV	244-2	no use indicated
C.H. Reid	306-011	SV	519	stream taking for dairy operation
I.R. Waid	60-104-01	SV	448-G	pond on property, no use indicated
A. Brkic	110-009	SV	35-2	pond on property, no use indicated
K. Chaput	60-030	SV	15-2	pond - no use indicated
W. Chlon	60-028	SV	238-2	pond - no use indicated
Nilomes Ltd.	60-98 60-101 307-052-10 307-051	SV SV SV SV	272	two ponds on 60-98, no use indicated

(Cont'd)

TABLE 18 SUMMARY OF LOCAL SURFACE WATER USE: LF-4N (continued)

Individuals Interviewed	Assessment Roll No.	Site(S) or Site Vicinity (SV)	Interview No.,GLAL Feild Visit No. (FV)	Surface Water Use Comments
W. Anderson	306-019	S	5-2	pond for livestock operation
Mrs. J. Peric	306-175	SV	43-2	no use indicated
R. Bousfield	302-177	SV	501-G	pond for irrigation use
E. Snow	306-083	SV	143-2	stream for cattle
H. Vanzwol	306-087	SV	125-2	pond for livestock operation
M. Hall	306-081	SV	486-G	pond on property and stream taking for agricultural use
A. Palermo	110-068	SV	123-1	pond for agricultural use
M.E. McLauchlan	306-017	S	215-1	no use indicated
Mrs. B. Hall	306-174	SV	78-2	pond and stream on property
N. Mogil	306-086	S	54-2	no use indicated
D. Sherwood	306-009	SV	55-2	no use indicated
D. LeBlanc	306-170	SV	49-2	pond for unspecified use
Mr. Attardo	306-020	SV	67-2	no use indicated
M.B. Kennedy	306-021	SV	84-1a	stream for horse operation and irrigation
J. DeAngeles	306-085-10	S	37-1a	pond for domestic garden use
P. Patrick	306-025	SV	47-1	pond for domestic garden use
A. Hall	60-062	SV	86-1a	stream used for irrigation, many springs in the area

(cont'd.)

TABLE 18 SUMMARY OF LOCAL SURFACE WATER USE: LF-4N (continued)

Individuals Interviewed	Assessment Roll No.	Site (S) or Site Vicinity (SV)	Interview No., GLAL Field Visit No. (FV)	Surface Water Use Comments
A. Mishos	60-023	SV	18-1a	stream taking to irrigate garden
P.J. Lambrick	60-059-01	SV	292	pond (springs near bush), no use indicated
W. Tomosky	60-067	SV	60-2	2 ponds (1 is spring fed) & stream, no use indicated
Mrs. A. Curtis	60-071	SV	39-2 44-2	pond & stream takings for agricultural use
R. Lash	60-009	SV	46-2	stream, pond, no use indicated
F. Opstein	60-090-01 110-009 60-087-01 60-088 60-088-01	SV SV SV SV SV	265-2	pond & stream takings for agricultural use
B. Kusiewicz	100-012	SV	629	stream taking for agricultural use
H. Gowland	60-067 60-094-10	SV SV	45-2	stream taking for agricultural use

TABLE 19 SUMMARY OF PERMITS TO TAKE WATER: LF-4N

PERMIT NUMBER	STREAM	PURPOSE	MAXIMUM DAILY AMOUNT (m^3)
77-P-3000	Middle Sixteen Mile Creek	Irrigation (tree nursery)	1,817
77-P-389	Middle Sixteen Mile Creek	Irrigation	352
69-P-347	Middle Sixteen Mile Creek	Irrigation	611
67-P-214	Middle Sixteen Mile Creek	Irrigation (golf course)	1,635
63-P-2617	Middle Sixteen Mile Creek	Irrigation (golf course)	981
66-P-385	East Sixteen Mile Creek	Irrigation	837
68-P-246	East Sixteen Mile Creek	Irrigation (market gardening)	296
78-P-3038	East Sixteen Mile Creek	Irrigation (crops)	1,635
67-P-113	Sixteen Mile Creek	Irrigation	131
74-P-3074	Sixteen Mile Creek	Irrigation (golf course)	--
81-P-3026	Bronte Creek	Recreation	1,136
65-P-438	Bronte Creek	Irrigation (golf course)	341

N.B. Sixteen Mile Creek is also known locally as Oakville Creek.

Twelve PTTW were identified in the study areas. Eleven permits were issued for irrigation purposes such as agricultural crops, market gardening, tree nursery, and golf courses. One permit was issued for recreational purposes (on Bronte Creek). No municipal or industrial permits were identified.

A measure of sensitive water usage downstream from LF-4N is provided by the DSWUI. Part A of Table 20 shows the DSWUI for Indian Creek downstream from the projected stormwater outfall. The DSWUI is 21.4. Part B of Table 20 shows the DSWUI for the preferred access routes to LF-4N, and between LF-4N and PI-13N. Part C shows the DSWUI for the alternative access routes between LF-4N and PI-1N.

TABLE 20 DOWNSTREAM WATER USE INDEX: LF-4N

STUDY AREA	LAND USE			DOWNSTREAM WATER USE INDEX
	WOODED	RECREATIONAL	RURAL	
A. Regional: Stormwater Outfall	13.3	1.0	7.1	21.4
B. Preferred Access Routes To LF-4N:				
From Hwy 401	89.5	225.9	35.5	350.9
From QEW	107.3	17.8	64.8	189.9
LF-4N to PI-13N:	196.7	33.0	47.1	276.8
C. Alternative Access Routes: LF-4N to PI-1N:				
Option 1	52.8	4.0	30.6	87.4
Option 2	60.2	8.0	28.4	96.6

*The numbers refer to alternative access routes listed in Section 1.6.4.

6.4 ACCESS ROUTES

The Stream Crossing Distances (SCD) for the preferred access routes to candidate site LF-4N and between LF-4N and PI-13N are presented below in Table 21. The SCDs for the alternative access routes between LF-4N and PI-1N are also given.

TABLE 21 STREAM CROSSING DISTANCES FOR ACCESS ROUTES: LF-4N

ACCESS ROUTE	STREAM CROSSING DISTANCE (m)
A. Preferred Access Routes:	
To LF-4N:	
From Hwy 401	2,210
From QEW	3,985
LF-4N to PI-13N:	2,185
B. Alternative Access Routes:	
LF-4N to PI-1N:	
Option 1	400
Option 2	500

* The numbers refer to alternative access routes listed Section 1.6.4.

6.5 RAIL ACCESS

Rail access to Site LF-4N crosses 1 to 2 minor streams, depending on the alignment taken. No floodplains or wetlands are crossed.

6.6 SUMMARY OF FINDINGS

Flood Susceptibility

- Site LF-4N is characterized by poor topographic relief, and is considered only moderately well drained with a permanent wetland area located near the south boundary of the site.

- Small areas of the extreme northwest and southwest corners of the site are designated floodplain land (Indian Creek).

- There is very little upstream area draining through the site.

- Inadequate culvert capacities can cause frequent and significant site flooding under existing conditions.

- Swales downstream from Culverts #16 and #17 do not appear to have sufficient capacity to prevent flooding.

Drainage Improvements

- Site drainage can be conveyed via perimeter ditching to the existing outlets, beneath Bell School Line and Britannia Road, or alternatively, all site runoff can be re-routed to the Indian Creek outlet at the southwest corner of the site.

- The preferred location of a stormwater outfall is near Culvert #1, in Indian Creek.

- No re-routing of runoff, major channelization or ditching around the perimeter of the site is anticipated.

- Approximately 1,400 m of downstream channelization may be required if existing outlets are maintained. Alternatively, if all site runoff is re-routed to Indian Creek near the southwest corner of the site, then it is expected that no significant off-site channelization would be required.

- Four culverts will require replacement if existing outlets are maintained, but only two would require replacement if runoff is re-routed to Indian Creek.

- Stormwater management ponds may be used to reduce post-development flows to pre-development levels reducing or eliminating the need for downstream improvements.

Water Use

- Local water use is considered to be relatively minor.

- No surface water is used for potable supplies.

- Stream water is used for livestock at one location within the site vicinity downstream from the storm water outfall.

- Twelve MOE PTTWs were identified.

- The regional use of surface water is mainly for irrigational purposes.

- No municipal water supply intakes were identified.

- The DSWUI is 21.4.

Access Routes

- Access routes cross many streams with significant potential for interference in the event of an accidental spill.
- There are major stream crossings (e.g. Sixteen Mile Creek).
- The Stream Crossing Distances range from 400 to 3985 m.
- The access road DWSUIs range from 87.4 to 350.9.

Rail Access

- 1 to 2 minor streams are crossed.

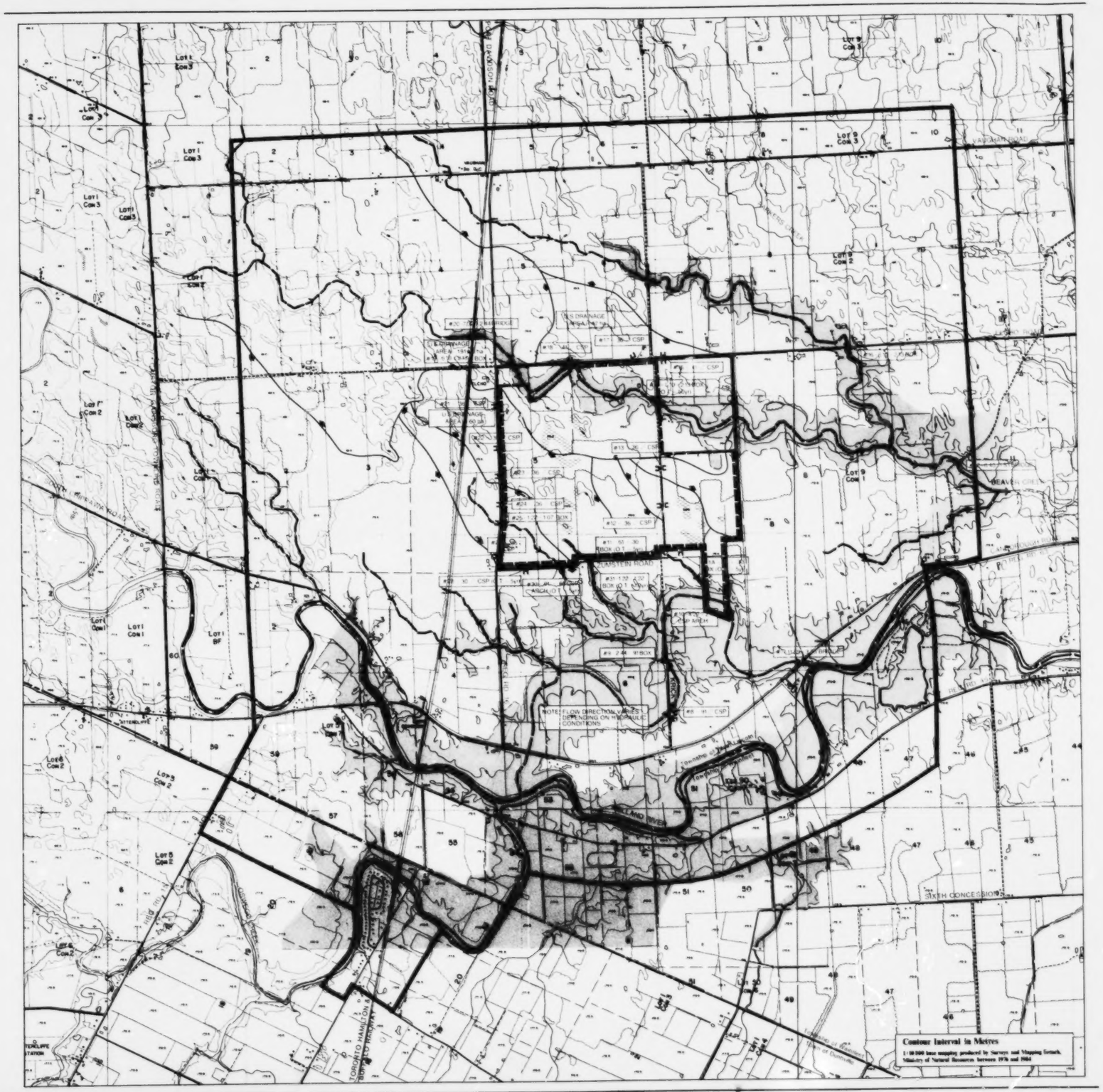
7.0 CANDIDATE SITE LF-3C SURFACE WATER CONSIDERATIONS

7.1 FLOOD SUSCEPTIBILITY

Most of this site is very flat, with elevations varying between 180 m a.s.l. and 178 m a.s.l. Surface drainage is generally poor, with numerous wet pockets observed during snow melt/ rainfall periods. The northern portion of the site drains toward Beaver Creek, a tributary of the Welland River. Beaver Creek enters the site near the northwest corner, beneath Elcho Road. It drains eastward through the site and discharges through the eastern boundary. The southern portion of the site drains southeastward via shallow swales to another unnamed tributary of the Welland River.

The Welland River Regional Storm floodplain is shown on Figure 30 in preliminary form. The floodplain extends to the southern boundary of the site as shown and along Beaver Creek through the northern portion of the site. The floodplain shown along Beaver Creek has been estimated from the backwater from the Welland River, and is not based on a hydraulic analysis of Beaver Creek itself. A detailed hydraulic analysis of Beaver Creek is required to accurately define the floodplain through the northern portion of the site. There are no major water-courses to the west which could cause site flooding.

Five outlet culverts were identified during field visits to this site. Beaver Creek flows from the site along the eastern boundary, but since there is no road along this boundary, there is no culvert or bridge crossing associated


Lot 1 Con 3
Lot 9 Con 3
Lot 9 Con 2
Lot 9 Con 1
Lot 8 Con 2
Lot 7 Con 2
Lot 6 Con 2
Lot 5 Con 2
Lot 4 Con 2
Lot 3 Con 2
Lot 1 Con 1
Lot 1 BF
Lot 5 Con 1
Lot 6 Con 1
DAVIDSON ROAD
CAISTORVILLE ROAD
BEAVER CREEK
#20 CSP BRIDGE
#18 CSP
#17 CSP
#16 CSP
#15 CSP
#14 CSP
#13 CSP
#12 CSP
#11 CSP
#10 CSP
#9 CSP
#8 CSP
#7 CSP
#6 CSP
#5 CSP
#4 CSP
#3 CSP
#2 CSP
#1 CSP
#30 CSP
#29 CSP
#28 CSP
#27 CSP
#26 CSP
#25 CSP
#24 CSP
#23 CSP
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#21 CSP
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#40 CSP
#41 CSP
#42 CSP
#43 CSP
#44 CSP
#45 CSP
#46 CSP
#47 CSP
#48 CSP
#49 CSP
#50 CSP

with this outlet. The drainage areas, culvert sizes and flow estimates etc., at each outlet are shown in Table 22. The culvert numbers (Column #2) are referenced to Figure 30. Comparison of flow estimates with culvert capacities indicates that, under existing conditions and with the exception of Culvert #31, all culverts are overtopped by the estimated five year return period storm flow. Culvert #31 would be overtopped by the ten year return period storm flow. Overtopping indicates a potential for site flooding, but the severity cannot be determined without more detailed topographic data. A more detailed analysis of flooding should be undertaken in Phase 4B, should this site remain under consideration.

In general, the 100 year return period peak flow estimates at the site outlet culverts are very low (1.0 - 3.8 m^3/s) and indicate a relatively minor need for the improvement of swales downstream to ensure onsite flooding does not occur. Preliminary estimates of downstream swale slopes (0.6 - 1.3% based on 1:10,000 topographic mapping) indicate that flooding from inadequate downstream swale capacities is not likely. However, these outlet swales may be effected by high water levels in the Welland River. The Beaver Creek outlet channel has a broad floodplain and a slope estimated to be only 0.05%. This very mild gradient, combined with the large Beaver Creek drainage area (2,100 ha), suggest that substantial flooding may occur within the northern portion of the site.

7.2 DRAINAGE IMPROVEMENT CONSIDERATIONS

As is the case for all of the landfill sites, the existing swales and drainage patterns would be eliminated due to the

TABLE 22 FLOOD SUSCEPTIBILITY DATA: LF-3C

No. of Outlets	Outlet Ref. # (see Fig. 30)	Drainage Area to Outlet (ha)	Size of Outlet (m)		Capacity of Outlet at: Top of Road (m^3/s)	Capacity of Outlet at: Obvert (m^3/s)	Flow Estimates (m^3/s) Q5 *	Q10 *	Q50 *	Q100 *	Approx. Slopes of Outlet Swales (%)
6	Beaver Creek	2100	-		-	-	21.3	25.3	33.0	36.3	0.05
	11A	2	0.6 x 0.3	Box	0.17	0.14	1.0	1.2	1.6	1.8	1.30
	11	22	0.6 x 0.3	Box	0.17	0.14	1.1	1.3	1.8	2.0	1.30
	29	06	0.3 Ø	CSP**	0.08	0.06	0.5	0.7	0.9	1.0	0.60
	30	4	0.9 x 0.6	Arch	0.59	0.45	1.1	1.3	1.8	2.0	0.60
	31	83	1.2 x 1.2	Box	2.60	2.40	2.2	2.5	3.4	3.8	0.60

* 5, 10, 50, 100 refers to the length (in years) of the return period of the storm under consideration

** Corrugated Steel Pipe

landfill mound and associated construction. The on-site drainage system would be improved by constructing perimeter ditches near the landfill boundaries. Ditch sizes would be minimized by draining the northern portion of the site to Beaver Creek, and the southern portion to one of the outlets along Zumstein Road.

The locations of the waste disposal facility components on this candidate site are severely constrained by potential flooding from the Welland River and from Beaver Creek. As shown on Figure 30, the only location for the facility (under existing flooding conditions) is between the Beaver Creek and Welland River floodplains. To reduce the possibility of site flooding, consideration has been given to eliminating or substantially reducing the width of these floodplains. The flood hazard could be eliminated and adequate outlets for site runoff ensured, by lowering the Welland River flood levels. This would require substantial alteration and improvements to the Welland River and the cost is likely to be prohibitive. Alternatively, small areas of the site could be re-graded and berms constructed to minimize the flood risk. The extent of berming adjacent to Beaver Creek would need to be confirmed in Phase 4B with more detailed hydraulic analysis of flood level. This alternative is expected to be less costly but it does not address the fact that there is potential for flooding to occur immediately to the north and south of the facility.

If this site is developed and the uncontrolled release of storm water is permitted, then peak flows are expected to increase significantly and some downstream channelization or culvert improvements may be required. Specifically, 2,500 m of channelization may be required downstream from Zumstein Road

and three culvert structures may require replacement. Alternatively, post-development stormwater flows can be reduced to pre-development levels using on-site detention storage. The required storage volume to control 100 year runoff to pre-development peak flows is estimated to be 37,000 m^3. The increase in runoff directed to Beaver Creek is expected to be minor in comparison to the total flow, and no downstream improvements are anticipated.

Interviews with landowners indicate that approximately 57 ha of the site are tile-drained, and this will have to be considered in the development of the site.

The preferred location of the storm water outfall is on Beaver Creek at Krick Road in the northeastern corner of the site as shown on Figures 30 and 31.

7.3 SURFACE WATER USE

The study area for investigating potential impacts on surface water usage as a result of the proposed integrated facility on candidate site LF-3C consists of Beaver Creek, the Welland River and the small tributaries of the Welland River which presently drain the site. The study area extends along these watercourses, downstream from the site to the Chippawa/ Queenston Power Canal and the Niagara River.

Major streams that are crossed by the alternative access routes to site LF-3C are also considered to be part of the study area. Included are Fifteen Mile Creek, Sixteen Mile Creek, Twenty Mile Creek, Beaver Creek and the Welland River. The study area extends from the access route crossing along the

DAWSON ROAD
Lot 1 Con 3
Lot 1 Con 2
Lot 1 Con 1
Lot 1 BF
SOUTH CAISTER ROAD
A Zantingh
Storm Water Outfall
W.Gerrytse
Wigniewski
ZUIDSTEIN ROAD
Niagara Peninsula Conservation Authority (Weir) P67511
Van Ravensway
Robert Land Academy
REG RD 116
Lot 5 Con 1
H.Black
W.Van Scelen
Huizinga
Jongsma
Lot 6 Con 2
Lot 5 Con 2
Lot 4 Con 2
Haag
Lagoon
TORONTO HAMILTON & BUFFALO RAILWAY

OWMC Ontario Waste Management Corporation

Consultant: Gartner Lee Associates Limited

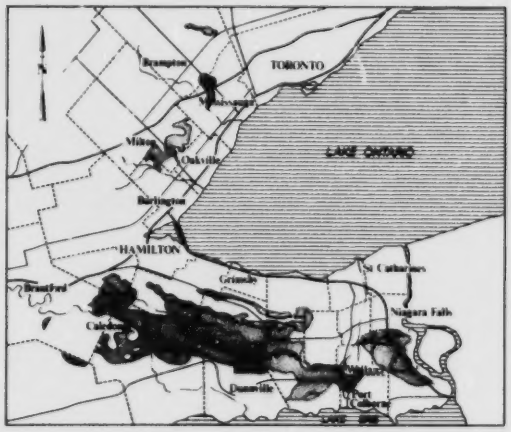
Legend:

- Municipal Intake
- Municipal Outfall
- Industrial Intake
- Industrial Outfall
- Recreation: B - beaches, S - swimming, Bt - boating, W - Winter Sports, P - Pond
- Rural Potable Supply
- Nonpotable Domestic Supply
- Livestock Watering (stream or pond)
- Irrigation - P.T.T.W. Permit To Take Water
- Farm Pond Unspecified Use or Unused
- Stream Taking - Unspecified Use

Proposed Acquisition Boundary
Phase 3B Acquisition Boundary
Site Vicinity Study Area Boundary

Key Map: LF-3 Central

Lots 5, 6 and 7; Concession 1; Part of Lot 7; Broken Front Concession; Township of West Lincoln; formerly in the Township of Gainsborough



1000 feet 0 1000
500 metres 0 500

EXISTING SURFACE WATER CONDITIONS, PHASE 4A

Local Surface Water Use

October 1985 FIGURE 31

watercourses to the point of discharge to either Lake Ontario, the Niagara River or Chippawa Power Canal (Figure 3).

7.3.1 LOCAL WATER USE

The results of the walk-and-talk questionnaires, meetings with local residents and site tours identified numerous uses of surface waters on the site and in the site vicinity. The findings of the walk-and-talk questionnaire and site tours are summarized in Table 23 and depicted on Figure 31*.

Ponds and Beaver Creek are used at two locations to provide water for livestock on the site. Ponds are also used for unspecified uses at five other locations on the site. Stream and ponds are used for a variety of domestic, agricultural and unspecified uses at 30 other locations on the site vicinity. The bulk (23 locations) of this use is for domestic nonpotable, and livestock watering uses, mainly along the Welland River, south of the site. During dry weather, the filling of farm ponds from streams appears to be a common practice in the area.

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* At the time of the walk-and-talk and other data collecting activities (summer and fall, 1984) the location of the storm water outfall had not been finalized. Consequently, local surface water use data were collected for all the streams downstream from the site. All of the data collected are shown on local surface water use figures of this report. For the purposes of comparative evaluation (GLAL, 1985a), only those uses of surface water downstream from the projected storm water outfall with the site vicinity (study area) were counted.

TABLE 23 SUMMARY OF LOCAL SURFACE WATER USE: LF-3C

Individuals Interviewed	Assessment Roll No.	Site (S) or Site Vicinity (SV)	Interview No., GLAL Field Visit No. (FV)	Surface Water Use Comments
R. Douma	8-119	S	63-2	no use identified
Elcho United Church	8-131	S	127-1	no use identified
	8-132			no use identified
George Gerryts	8-95	SV	224-2/FV	stream on property, no use identified
	8-48	SV	224-2/FV	stream on property, no use identified
	8-75	SV	224-2/FV	stream taking for livestock operation & domestic supply
W. Gerryts	8-48	SV	102-2	pond taking for livestock operation
A. Huizinga	8-79	SV	83-2/FV	pond for livestock operation
	8-99	SV	83-2	no use identified
	8-78	SV	83-2	no use identified
E. Cosby	8-4	S	115-2/FV	two ponds and stream on property, no use indicated
Robert Land Academy	8-84	SV	FV	stream taking for public potable water supply
	8-85			
Mr. Heeg	5-009	SV	FV	pond taking for dairy farm operation
Oswega Park	5-027-50	SV	FV	subdivision no use identified
H. Black	8-81	-	FV	pond taking for livestock operation
Mr. Van Ravensburg	-	SV	FV	pond taking for dairy cattle operation
Mr. Bootsma	7-193	SV	FV	pond & stream taking for dairy cattle operation & domestic supply
Mr. Petter	8-77	SV	FV	pond & stream taking for dairy cattle operation & domestic supply

(cont'd)

TABLE 23 SUMMARY OF LOCAL SURFACE WATER USE: LF-3C (continued)

Individuals Interviewed	Assessment Roll No.	Site (S) or Site Vicinity (SV)	Interview No., GLAL Field Visit No. (FV)	Surface Water Use Comments
E. Peaire	8-3	S	7-2 FV (5)	stream on property no use identified
Dr. D. Ullman	8-3	S	16-1	no use identified
N. Vaughan	8-3 8-76	S SV	FV (1+7)	no use identified pond & stream on property for livestock use
J. Krahne	8-7	S	242-1	no use identified
Mr. Zumstein	8-151-1	SV	104-7	no use identified
R. & H. Janssens	8-6 8-152 8-148 8-130	SV	219-2	no use identified
G. & H. Vanmarrum	8-35-1 8-189	S SV	694	pond takings for livestock operation, stream on property
J. Aantjes	8-125	SV	91-2/FV	no use identified
W. Van Soelen	8-101	SV	92-2 FV	pond and stream on property, no use indicated
T. Wisniewsk	8-35	S	65-3	pond taking for unspecified agricultural use, streams on property
A. Zantingh	8-49	SV	105-2	pond taking for livestock operation
B. Wagter	8-116 8-98	SV -	- -	ponds & stream for livestock operation
J. Swayze	8-127	S	-	ponds & streams, no use identified
G. Gilmer	8-148	SV	81-2	ponds and streams on property, no use identified
L. Douma	8-120	S	62-1a	stream, no use indicated
Vanderweir/Baarda	8-36	S	818/854/821a	pond & stream for livestock use
P. Davis	8-129	S	69-1	ponds & streams on property, no use identified

(cont'd)

TABLE 23 SUMMARY OF LOCAL SURFACE WATER USE: LF-3C (continued)

Individuals Interviewed	Assessment Roll No.	Site (S) or Site Vicinitv (SV)	Interview No., GLAL Field Visit No. (FV)	Surface Water Use Comments
Jorgsma	8-78	SV	FV	pond & stream taking for hog farm operation
Van Hell	13-133 13-132	SV SV	FV FV	pond & stream taking for dairy cattle operation
Kiers	8-124	SV	FV	stream taking for dairy cattle operation
B. Wagter	Lot 20, Conc.1	SV	FV	pond & stream taking for livestock operation
Niagara Peninsula Conservation Authority	-	SV	FV	weir on the Welland River
B. van Soelen	13-129	SV		domestic supply from Welland River plus livestock operation

The Robert Land Academy draws water from the Welland River, upstream from the site, for drinking and domestic purposes. The Robert Land Academy is a boarding school located approximately two kilometres southwest of the site. The water intake for the academy is approximately 15 km upriver from the confluence of the Welland River and Beaver Creek. Dils Lake, in the Chippawa Creek Conservation Park, and the Welland River were identified as recreational water uses, i.e. camping, boating, fishing and winter sports. The Niagara Peninsula Conservation Authority was issued a PTTW for recreational purposes a short distance upstream from the Robert Land Academy.

The projected storm water outfall would be located in Beaver Creek at Krick Road, Figure 31. The walk-and-talk program did not locate any uses of surface water on Beaver Creek downstream from the projected storm water outfall within the site vicinity.

7.3.2. REGIONAL WATER USE

A total of seven MOE Permits to Take Water were identified downstream from candidate site LF-3C and/or its alternative access routes (see Figures 3 and 31). The PTTWs are summarized in Table 24.

Four permits were identified on creeks that are downstream from the Regional Road 24 access route option. Three of these permits were for irrigation purposes and were issued on Twenty Mile Creek (2) and Sixteen Mile Creek (1). One permit was noted on Twenty Mile Creek for recreation and fire fighting purposes.

TABLE 24 SUMMARY OF PERMITS TO TAKE WATER: LF-3C

PERMIT NUMBER	STREAM	PURPOSE	MAXIMUM DAILY AMOUNT (m^3)
63-P-2727	Twenty Mile Creek (Jordan Harbour)	Irrigation	--
74-P-0007	Twenty Mile Creek (Jordan Harbour)	Irrigation	63.4
74-P-2000	Twenty Mile Creek	Recreation and Fire Fighting	--
65-P-679	Sixteen Mile Creek	Irrigation (fruit)	--
76-P-2077	Welland River	Irrigation (crops)	47.6
67-P-489	Welland River	Irrigation (golf course)	124
77-P-2058	Welland River	Industrial	321

Three permits were identified on the Welland River downstream from site LF-3C and the alternate access routes. Two permits were issued for irrigation purposes (crops and golf course). One permit on the Welland River was issued for industrial purposes.

In addition to the water taking permits mentioned above four industrial intakes and five industrial outfalls were identified in the lower reaches of the Welland River. These are shown on Figure 3 and Table 25. Industrial intake #124 (B.F. Gooderich) was identified previously as MOE Permit #77-P-2058.

TABLE 25 SUMMARY OF DOWNSTREAM MUNICIPAL AND INDUSTRIAL INTAKES AND OUTFALLS: LF-3C & LF-9C

REFERENCE NUMBER*	NAME	LOCATION
100	City of Niagara Falls WTP Intake	Chippawa Ck.
119	City of Welland WTP Intake	Welland Canal
121	Atlas Steel Outfall	Welland River
122	City of Welland STP Outfall	Welland River
124	B.F. Goodrich Intake	Welland River
125	B.F. Goodrich Outfall	Welland River
126	Cyanamid Intakes (2)	Welland River
127	Cyanamid Outfall	Welland River
128	Ford Glass Outfall	Welland River
129	Ford Glass Intake	Welland River

* From Surface Waters of the Golden Horshoes as Effluent Receivers (PHASE 3 - INTERIM); GLAL et al, 1984.

****

Two water treatment plant (WTP) intakes are listed in Table 25 and shown on Figure 3. They are for the City of Niagara Falls (on Chippawa Creek)** and the City of Welland (on the Old Welland Canal). Under normal circumstances neither of these intakes could be effected by discharges from LF-3C.

** The Welland River is also known locally as Chippawa Creek.

The Niagara Falls intake is on the section of the Chippawa Creek (Welland River) which flows west from the Niagara River towards the intake of the Chippawa/Queenston Power Canal. Occasionally the Chippawa/Queenston Power Canal is closed by Ontario Hydro for maintenance work. During this closure, the flow in the Chippawa Creek is eastwards and thus the Welland River would flow past the Niagara Falls intake. The closure is typically for periods of a few weeks and occurs once every decade. (Personal Communication; A. Wilson, Ontario Hydro, 1983).

The City of Welland intake is on the Old Welland Canal which is not hydraulically connected to the Welland River at Welland. During the spring ice break/snow melt period, ice jams have been reported at the siphon where the Welland River passes beneath the Old Welland Canal. On these occasions the Welland River water level rises sufficiently to spill over into the canal, upstream from the City of Welland WTP intake. The ice jams occur seasonally and less frequently than once per year (Personal Communication; D. Crump, West Central Region, Ontario Ministry of the Environment, 1985). Such a jam occurred in February, 1985.

It should be noted that during such occurrences the flow rate of the Welland River is usually quite high. The months of February, March and April have three of the four highest monthly flow rates for the lower Welland River (Station 02HA007 near Caistor Corners) (Historical Streamflow Summary, Ontario To 1982; Environment Canada, 1983). Consequently the capacity of the Welland River to dilute stormwater from the site is highest during the months when ice jams are possible.

These potential pathways to humans were considered to be minor due to their expected low frequency of occurrence of the canal cleaning or ice jams. If Site LF-3C remains in consideration during Phase 4B these potential (infrequent) pathways should be addressed in more detail with respect to contingency planning.

An indication of sensitive surface water usage downstream from the proposed stormwater outfall is by the DSWUI, presented in Part A of Table 26. The table shows the distribution of land uses which are likely to have sensitive low-volume usage of surface water. The DSWUI for LF-3N is 43.

The DSWUIs associated with alternative access routes are given in Part B of Table 26. The access road DSWUIs for this site range from 824 to 937. Note that the study areas for access route DSWUIs include streams downstream from the access roads to the potential ultimate receivers ie. Lake Ontario and the Chippawa/ Queenston Power Canal.

TABLE 26 DOWNSTREAM WATER USE INDEX: LF-3C

STUDY AREA	LAND USE			DOWNSTREAM WATER USE INDEX
	WOODED	RECREATIONAL	RURAL	
A. Regional: Stormwater Outfall	2.1	1.0	39.9	43.0
B. Alternative Access Routes:				
Option 1*	78.9	12.3	731.5	823.7
Option 6	80.9	14.3	841.6	936.8

* The numbers refer to the alternative access routes listed in Section 1.6.5.

7.4 ACCESS ROUTES

The Stream Crossing Distances (SCD) for each of the alternative access routes to candidate site LF-3C are presented in Table 27.

TABLE 27 STREAM CROSSING DISTANCES FOR ACCESS ROUTES: LF-3C

ACCESS ROUTE	STREAM CROSSING DISTANCE (m)
Option 1*	5,945
Option 2	6,115

* The numbers refer to alternative access routes listed in Section 1.6.5.

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7.5 RAIL ACCESS

Rail access to LF-3C crosses 0 or 1 minor stream depending on the alignment considered. No floodplains or wetlands are crossed.

7.6 SUMMARY OF FINDINGS

Flood Susceptibility

- Site LF-3C is characterized by poor topographic relief and is generally poorly drained.

- The Welland River floodplain extends to the southern site boundary and through the northern portion of the site along Beaver Creek.

- The total upstream area draining through the site exceeds 2,100 ha.

- Inadequate outlet culvert capacities may potentially cause site flooding under existing conditions.

- Outlet swales along the southern boundary generally have sufficient slope to adequately convey the smaller, more frequent runoff flows away from the site without causing a backwater onto the site. However, with larger, less frequent events (e.g. the 100 year return period or Regional Storm), the outlet swale capacities may be affected by high water levels in the Welland River. The Beaver Creek outlet slope is very mild and is likely to contribute to high water levels through the northern portion of the site.

Drainage Improvements

- The cost of eliminating or reducing the width of the flood plains bordering the operational areas on this site could be prohibitive. Alternatively, minor portions of the site could be re-graded and bermed to provide adequate flood protection.

- Runoff from the site can be routed to Beaver Creek in the north and Zumstein Road to the south via perimeter ditching.

- The preferred stormwater outfall location is at the culvert of Krick Road over Beaver Creek.

- The upstream area draining through the site along the

western site boundary can be intercepted with ditching along Regional Road 16 and the runoff conveyed around the perimeter of the site to a tributary of Welland River.

- 2,500 m of downstream channelization may be required to ensure that water levels are not increased after the site is developed.

- Three downstream road crossings may require replacement to accommodate increased flows.

- On-site storm water management ponds may be used as an alternative method to reduce post-development storm runoff flows to predevelopment levels, thus reducing or eliminating the need for downstream improvements.

Surface Water Use

- Local surface water use in the site vicinity downstream from the projected storm water outfall is considered to be low.

- Stream water and ponds are used frequently in the site vicinity for livestock watering and once for domestic use.

- There are recreational uses on Welland River and Chippawa Creek Conservation Area (Dils Lake).

- Seven MOE PTTWs were identified (primarily irrigation).

- There are four industrial intakes and five industrial outfalls on the Welland River, upstream from the Chippawa Power Canal.

- The DSWUI is 43.0.

Access Routes

- Four major watercourses are crossed (Fifteen Mile Creek, Sixteen Mile Creek, Twenty Mile Creek, and Beaver Creek).

- The SCDs range from 5,945 m to 6,115 m.

- The access road DSWUIs range from 823.7 to 936.8.

Rail Access

- 0 or 1 minor stream is crossed.

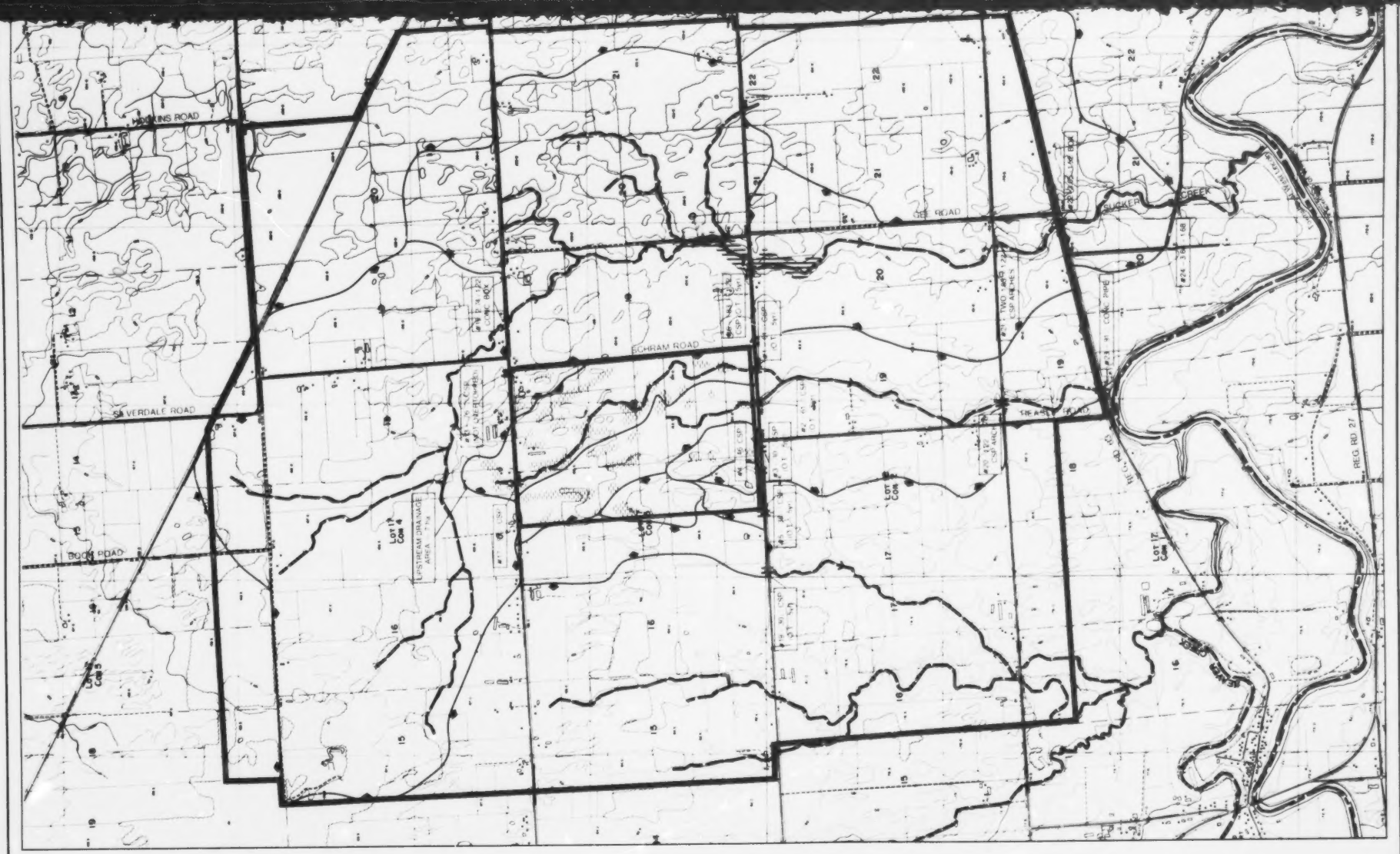
8.0 CANDIDATE SITE LF-9C
SURFACE WATER CONSIDERATIONS

8.1 FLOOD SUSCEPTIBILITY

This site is characterized by very little topographic relief, and is poorly drained. Drainage is from north to south via very shallow field swales. Much of this site is subject to local ponding during periods of snowmelt or wet weather.

Most of this site is drained by a minor swale that conveys runoff from the site, beneath Vaughan Road East, and directly south to the Welland River. The extreme northeast corner of the site drains to Sucker Creek upstream from Silverdale Road, while the southwest corner of the site is drained by another small Welland River tributary. There is no floodplain mapping available in the vicinity of this site. The only watercourse of significance in the area is Sucker Creek, located to the north and east of the site. Based on analysis of available topographic mapping and on-site visits, it does not appear that the Sucker Creek floodplain could encroach upon the site during the Regional Storm or affect the capacity of outlet swales. This should be confirmed in Phase 4B, should this site remain under consideration. There are no major watercourses which could cause site flooding to the west of the site. Several low lying/swamp areas have been identified on this site as shown on Figure 32.

Six outlet culverts were identified during field visits to this site. The drainage areas, culvert sizes, flow estimates, etc., at each outlet culvert are shown in Table 28. The culvert reference numbers (Column #2) are referenced to Figure 32.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LOT 17 CON 999
LOT 17 CON 1000

OWMC Ontario Waste Management Corporation

Consultant:

DILLON

Gartner Lee Associates Limited

Legend:

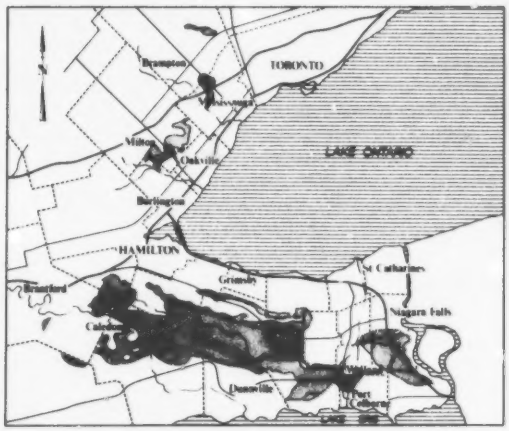
- Flood-Prone Area
- Swamp or Low Lying Area
- Channel or Swale
- Watershed Divide
- Culvert or Bridge Crossing
- Crossing Overtopped For Estimated Flow (Inlet Control)
- CSP — Corrugated Steel Pipe
- Culvert Identification Number, Size (m) and Type

Note: All Culvert Dimensions in Meters

Phase 3B Acquisition Boundary — Site Vicinity Study Area Boundary

Key Map: LF-9 Central

Lot 18 and Part of Lot 17; Concession III; Township of West Lincoln; formerly in the Township of Gainsborough



1000 feet 0 1000
500 metres 0 500

Existing Surface Water Conditions
PHASE 4A

Surface Drainage: LF-9C

October 1985 FIGURE 32

TABLE 28 FLOOD SUSCEPTIBILITY DATA: LF-9C

No. of Outlets	Outlet Ref. # (see Fig. 32)	Drainage Area to Outlet (ha)	Size of Outlet (m)	Capacity of Outlet at: Top of Road (m^3/s)	Capacity of Outlet at: Obvert (m^3/s)	Flow Estimates (m^3/s) Q5*	Q10*	Q50*	Q100 *	Approx. Slopes of Outlet Swales (%)
6	1	51	0.6 Ø CSP**	0.48	0.34	1.3	1.5	2.1	2.2	0.4
	2	42	0.6 Ø CSP	0.48	0.34	1.1	1.3	1.8	2.0	0.4
	3	12	0.3 Ø CSP	0.14	0.06	0.5	0.6	0.8	0.9	0.4
	4	4	0.46 Ø CSP	0.31	0.17	0.4	0.5	0.6	0.7	0.4
	5	8	0.38 Ø CSP	0.25	0.11	0.6	0.8	1.1	1.2	0.6
	13	6	0.76 Ø CSP	1.13	0.57	0.4	0.5	0.7	0.7	

* 5, 10, 50, 100 refer to the length (in years) of the return period of the storm under consideration
**Corrugated Steel Pipe

Comparison of flow estimates with culvert capacities indicates that five of the six outlets will be overtopped under existing conditions for the five year storm flow. The sixth culvert (#13 on Figure 32) is not overtopped because it drains a very small area in the northeast corner of the site. Overtopping indicates inadequate culvert capacity, which has potential for causing the backup of flood waters onto the site. On a flat site such as this one, flooding as a result of insufficient outlet culvert capacities can be potentially more severe than on a steeper site, where the backwater cannot persist because of the topography. More detailed topographic data are required to assess the potential severity of flooding due to the inadequate outlet culverts. A more detailed analysis of flooding should be undertaken in Phase 4B, should this site remain under consideration.

In general, 100 year peak flow estimates at the site outlets are very low (0.74 - 2.2 m^3/s) owing to the mild gradient, small areas draining to each outlet and the small upstream area which drains through the site. This suggests that down stream swales need not be very large to ensure that the site is not flooded by a backwater from downstream. Field observations indicate that the outlet swales appear to be very broad and shallow. Crops have been planted through some of the swales. This cropping practice certainly decreases the capacity of the downstream swales and may possibly affect site flooding.

8.2 DRAINAGE IMPROVEMENT CONSIDERATIONS

As with all of the candidate landfill sites, the existing swales and drainage patterns would be eliminated due to site/facility development and associated construction. The on-site drainage system would be improved by constructing perimeter ditches near the site boundaries. The runoff flowing into

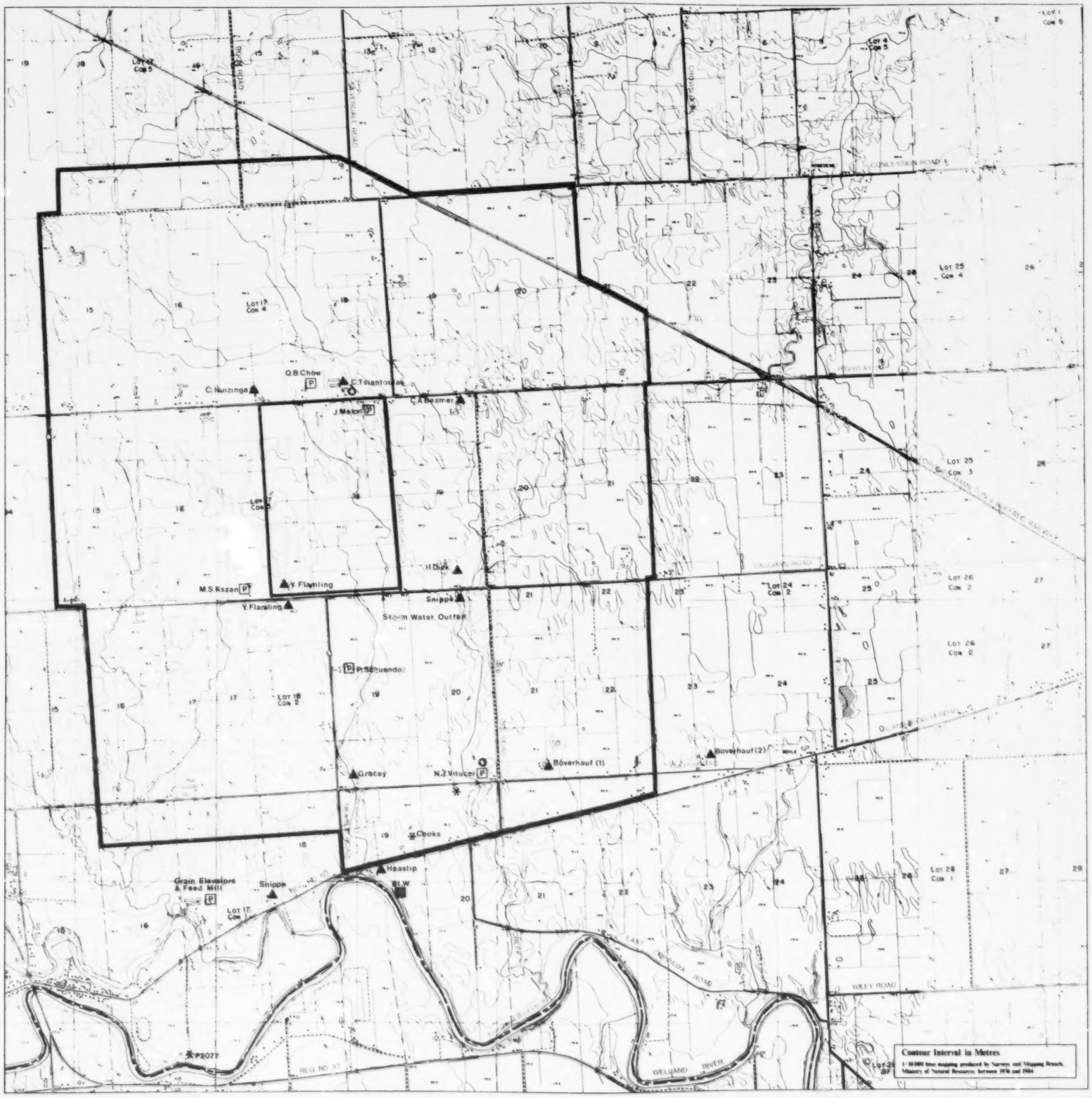
the northern boundary of the site (e.g. upstream from Culvert #17) could be diverted along Hwy 20 and Silverdale Road to Sucker Creek. All site runoff could be collected and conveyed to one outlet at the southern boundary of the site. Either the swale downstream from Culvert #2, or Sucker Creek, just east of the site, could be used as an outlet for site runoff.

Considering that the peak flow rates from the developed site are expected to increase substantially, downstream channel improvements and structure replacement may be required. Specifically, channelization lengths of 2,100 m or 3,500 m may be required downstream from Culvert #2 or along Sucker Creek, respectively. The Culvert #2 outlet swale could require replacement of three structures and the Sucker Creek outlet could require replacement of five structures. Detailed hydrologic and hydraulic analyses will be required to determine which outlet is the most effective and economical.

Control of peak flow rates from the site to pre-development levels can be accomplished with on-site detention storage. This could reduce or eliminate the need for downstream improvements. The required storage volume to control the 100 year return period runoff to pre-development peak flows is approximately 31,000 m^3.

Interviews with landowners indicate that 18.6 ha of the site are tile-drained and therefore tile-drain removal may be required.

The preferred location of the storm water outfall is at Culvert #6 near the southeastern corner of the site on Vaughan Road. Storm water would then flow east (beside Vaughan Road) to Sucker Creek and thus to the Welland River. This location is shown on Figures 32 and 33.



OWMC Ontario Waste Management Corporation

Consultant: Gartner Lee Associates Limited

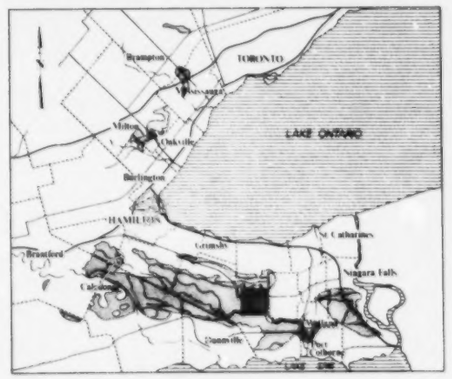
Legend:

- Municipal Intake
- Municipal Outfall
- Industrial Intake
- Industrial Outfall
- Recreation: B - beaches, S - swimming, Bt - boating, W - Winter Sports, P - Pond
- Rural Potable Supply
- Nonpotable Domestic Supply
- Livestock Watering (stream or pond)
- Irrigation - P.T.I. M.O.E. Permit To Take Water
- Farm Pond Unspecified Use or Unused
- Stream Taking Unspecified Use

Phase 3B Acquisition Boundary — Site Vicinity Study Area Boundary

Key Map: LF-9 Central

Lot 18 and Part of Lot 17; Concession III; Township of West Lincoln; formerly in the Township of Gainsborough



1000 feet 0 1000
500 metres 0 500

EXISTING SURFACE WATER CONDITIONS, PHASE 4A

Local Surface Water Use

October 1985 FIGURE 33

8.3 SURFACE WATER USE

The study area for identifying surface water uses that may potentially be effected by the development of site LF-9C as an integrated facility consists of Sucker Creek and the Welland River. In addition, portions of Twenty Mile Creek, Sixteen Mile Creek and Fifteen Mile Creek (from the access route crossing downstream to Lake Ontario) are considered to be part of the study area (Figure 3).

8.3.1 LOCAL WATER USE

The results of the walk-and-talk program and discussions with local residents identified fourteen beef cattle and dairy operations within 2 km of the centre of the site (Table 29). At twelve locations within the site vicinity, surface water is used for livestock operations. At two locations it is used for nonpotable domestic supplies (Figure 33)*.

Generally, domestic and potable water supplies are taken from cisterns because of poor ground water yields and variable ground water quality (Site Selection Process Phase 4A: Selection of a Preferred Site - Geologic, Hydrogeologic and Geotechnical Considerations; GLAL, 1985b). Cisterns are typically filled by a combination of rain water and water trucked in from municipal sources. The surveys did not identify any local surface water source that was used for potable purposes.

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* At the time of the walk-and-talk and other data collecting activities (summer and fall, 1984) the location of the storm water outfall had not been finalized. Consequently, local surface water use data were collected for all the streams downstream from the site. All of the data collected are shown on local surface water use figures of this report. For the purposes of comparative evaluation (GLAL, 1985a) only those uses of surface water downstream from the projected storm water outfall with the site vicinity (study area) were counted.

TABLE 29 SUMMARY OF LOCAL SURFACE WATER USE: LF-9C

Individuals Interviewed	Assessment Roll No.	Site (S) or Site Vicinity (SV)	Interview No., GLAL Field Visit No. (FV)	Surface Water Use Comments
H. Diek	10-76	SV	88-2 FV #9	pond use for dairy operation
Morningstar Bros.	10-106	S	38-2	no use identified
Y Flamling	10-81	S	FV #10	pond for livestock operation
	7-268	SV		
J. Melon	10-105	S	97-2 FV #11	pond, no use identified
Spratts	7-272	SV	FV #12	no use identified
Frier	N/A	-	FV #13	no use identified
Grain elevators & feed mill	N/A	SV	FV #14	pond, no use identified
Comfort	10-85	-	FV #15	no use identified
Gracey	7-14	SV	FV #16	stream taking for dairy operation, domestic water from cistern
	6-111	-	FV #7	no use identified
Boverhauf (1)	6-198	SV	FV #18	stream taking for dairy operation
Frier	N/A	-	FV #19	no use identified
Boverhauf (2)	-	SV	FV	pond taking for dairy operation
Cooks	7-143	SV	FV	pond and stream takings for irrigation
Snippe	7-264		FV	pond taking for dairy operation
G. Miller	10-239	SV		no use indicated

(cont'd)

TABLE 29 SUMMARY OF LOCAL SURFACE WATER USE: LF-9C (continued)

Individuals Interviewed	Assessment Roll No.	Site (S) or Site Vicinity (SV)	Interview No., GLAL Field Visit No. (FV)	Surface Water Use Comments
P. Maylott	10-77	SV	110 - A	intermittent stream, no use identified
C. Huizinga	10-162	SV	220-2 FV #1	pond taking for dairy operation
K. Beamer	10-101	SV	119-2	intermittent stream no identified use
C. Tsiantoulas	10-160	SV	118-2 FV #2	pond for livestock operation & domestic use
C.B. Chou	10-161	SV	223-2	pond
J.W. Murdock	10-241	SV	557	no use identified
Miss N.J. Vitucci	7-240-5	SV	468-G FV #3	pond for unspecified agricultural, domestic & domestic garden uses
Wm. DeVries	10-108	SV	478-G	domestic water imported by tanker
P. Schuender	7-15	SV	8-2-MF	pond and stream not currently in use.
	7-16	SV	FV #5	no use identified
	7-20	SV	8-2	
M S. Kszan	10-80	S	96-2 FV #7	pond on property, no use identified
	10-111	SV	96-2	
	10-16	SV	96-2	
	10-82	SV	96-2 FV #6	
C.A. Beamer	10-100	SV	87-2 FV #8	intermittent stream & pond for livestock operation
	10-155	SV	87-2	no use identified
R. Allen	7-271	SV	548	no use identified

(cont'd)

TABLE 29 SUMMARY OF LOCAL SURFACE WATER USE: LF-9C (continued)

Individuals Interviewed	Assessment Roll No.	Site (S) or Site Vicinity (SV)	Interview No., GLAL Field Visit No. (FV)	Surface Water Use Comments
Heaslip	-	SV	FV	pond & stream takings for dairy operation

Some recreational uses were identified on the Welland River downstream from Sucker Creek. These include boating and winter sports (snowmobiling, cross-country skiing). It is not anticipated that these types of activities would be sensitive to stormwater drainage released from the proposed facilities.

Downstream from the projected stormwater outfall, the walk-and-talk program identified one location where stream water was used for a livestock operation and another location where the stream is used for irrigation, within the site vicinity.

8.3.2 REGIONAL WATER USE

Six MOE Permits to Take Water (PTTW) were identified on watercourses downstream from Site LF-9C and its preferred access route (Figures 3 and 33). The PTTW are summarized in Table 30.

Three permits were issued on Twenty Mile Creek. Two were for irrigation purposes and one for recreation and fire-fighting purposes. One permit was issued on Sixteen Mile Creek for the irrigation of fruit crops. Two permits were identified on Welland River downstream from Sucker Creek and Site LF-9C. One permit was issued for the irrigation of a golf course and the other for an industrial intake.

In addition to the above mentioned permits four industrial intakes and five industrial outfalls were identified in the lower reaches of the Welland River, see Figures 3 and 16, and Table 25. Industrial Intake #124 (B.F. Goodrich) was previously identified as MOE Permit #77-P-2058.

TABLE 30 SUMMARY OF PERMITS TO TAKE WATER: LF-9C

PERMIT NO.	STREAM	PURPOSE	MAXIMUM DAILY AMOUNT (m^3)
63-P-272	Twenty Mile Creek (Jordan Harbour)	Irrigation	-
74-P-0007	Twenty Mile Creek (Jordan Harbour)	Irrigation	50.2
74-P-2000	Twenty Mile Creek	Recreation and Fire Fighting	-
65-P-679	Sixteen Mile Creek	Irrigation (fruit crops)	-
76-P-489	Welland River	Irrigation (golf course)	29.8
77-P-2058	Welland River	Industrial	381.0

Two water treatment plants (WTP) are listed in Table 25 and shown on Figure 3. They are for the City of Niagara Falls (on Chippawa Creek) and the City of Welland (on the Welland Canal). Under normal circumstances neither of these intakes would be effected by discharge of storm water from LF-9C.

The Niagara Falls WTP intake is on a section of Chippawa Creek (Welland River) which flows west from the Niagara River towards the Chippawa/Queenston Power Canal. Occasionally the Chippawa Power Canal is closed by Ontario Hydro for maintenance work. During the closure, the flow in the Chippawa Creek is eastwards, and thus the Welland River would flow past the Niagara Falls intake. The closure is typically for periods of

a few weeks and occurs in the order of once every decade. (Personal Communication; A. Wilson, Ontario Hydro, 1983)

The Welland WTP intake is located on the Welland Canal. The canal is not hydraulically connected to the Welland River at Welland. During the spring ice break/snow melt period, ice jams have been reported at the siphon where the Welland River passes beneath the Welland Canal. On these occasions the water level in the Welland River rises sufficiently that it spills over into the Canal, upstream from the City of Welland WTP intake. The ice jam occurs seasonally and less frequently than once per year (Personal Communication; D. Crump, West Central Region, Ontario Ministry of the Environment, 1985) Such an ice jam occurred in February, 1985.

It should be noted that during such occurrences the flow rate of the Welland River is usually quite high. The months of February, March and April have three of the four highest monthly flow rates for the lower Welland River (Station 2HA007 near Caistor Corners) (Historical Streamflow Summary, Ontario to 1982; Environment Canada, 1983). Consequently the capacity of the Welland River to dilute stormwater from the site is highest during the months when ice jams are possible.

These potential pathways to humans were considered to be minor due to the low frequency of occurrence of canal cleaning/ ice jams. If Site LF-9C remains in consideration during Phase 4B then these potential pathways should be addressed in more detail with respect to contingency planning.

An indication of sensitive surface water usage downstream from the proposed stormwater outfall is given by the

DSWUI presented in Part A of Table 31. This table shows the distribution of landuses which potentially support sensitive low-volume usage of surface water, downstream from the storm-water outfall. The DSWUI for LF-9C is 36.3. The distribution of land uses with sensitive water use downstream from the preferred access route is given in Part B of Table 31. The access route DSWUI is 329.5.

TABLE 31 DOWNSTREAM WATER USE INDEX: LF-9C

STUDY AREA	LAND USE			DOWNSTREAM WATER USE INDEX
	WOODED	RECREATIONAL	RURAL	
A. Regional: Stormwater Outfall	0.0	1.0	35.3	36.3
B. Preferred Access Route:	73.0	2.3	254.2	329.5

8.4 PREFERRED ACCESS ROUTE

The Stream Crossing Distance for the preferred access route to Site LF-9C is 4,945 m.

8.5 RAIL ACCESS

Rail access to LF-9C crosses several streams and wetlands, depending on the alignment considered.

Northern alignments cross one to three minor streams and five wetlands. Eastern alignments cross two to four streams (including Sucker Creek) and eight small wetlands.

8.6 SUMMARY OF FINDINGS

Flood Susceptibility

- Site LF-9C is characterized by poor topographic relief and is generally poorly drained.

- No part of the site is located on designated floodplain land. However, if this site is given further consideration, the floodplain of Sucker Creek, to the north and east of the site, should be mapped.

- Outlet culverts are small and will be overtopped frequently under existing conditions.

- Outlet swales do not appear to have sufficient capacity to convey runoff without causing some backup onto the site.

Drainage Improvements

- On-site drainage could be conveyed to the swale downstream from Culvert #2 or via new perimeter ditching to Sucker Creek.

- The preferred location for the stormwater outfall is at Culvert #6. The stormwater would then flow into Sucker Creek.

- The small upstream area which drains through the site from the north could be re-routed to the east along Highway 20 and then north along Silverdale Road to Sucker Creek.

- 2,100 m of channel improvements could be required using the swale downstream from Culvert #2, while 3,500 m of channel improvements could be required along Sucker Creek.

- Three crossings could require replacement if the swale downstream from Culvert #2 is selected as the outlet while five crossings would require replacement if Sucker Creek was chosen as the outlet.

- Alternatively, on-site storm water management ponds may be used to reduce post-development flows to pre-development levels, reducing or eliminating the need for downstream improvements.

Surface Water Use

- The use of surface water on the site and in the site vicinity is moderate.

- No stream water is taken for domestic or potable supply, downstream from the stormwater outfall within the site vicinity.

- Surface water use in the site vicinity is mainly for livestock operations.

- There are recreational uses of surface water on the Welland River.
- Six MOE PTTWs were identified.
- There are four industrial intakes and five industrial outfalls on the Welland River downstream from the site.
- The DSWUI is 36.3.

Access Routes

- Three major watercourses are crossed (Fifteen Mile Creek, Sixteen Mile Creek, and Twenty Mile Creek).
- The Stream Crossing Distance is 4,945 m.
- The access route DSWUI is 329.5.

Rail Access

- Some alignments cross 1 to 4 streams (including Sucker Creek), and small wetlands.

9.0 CANDIDATE SITE LF-1E SURFACE WATER CONSIDERATIONS

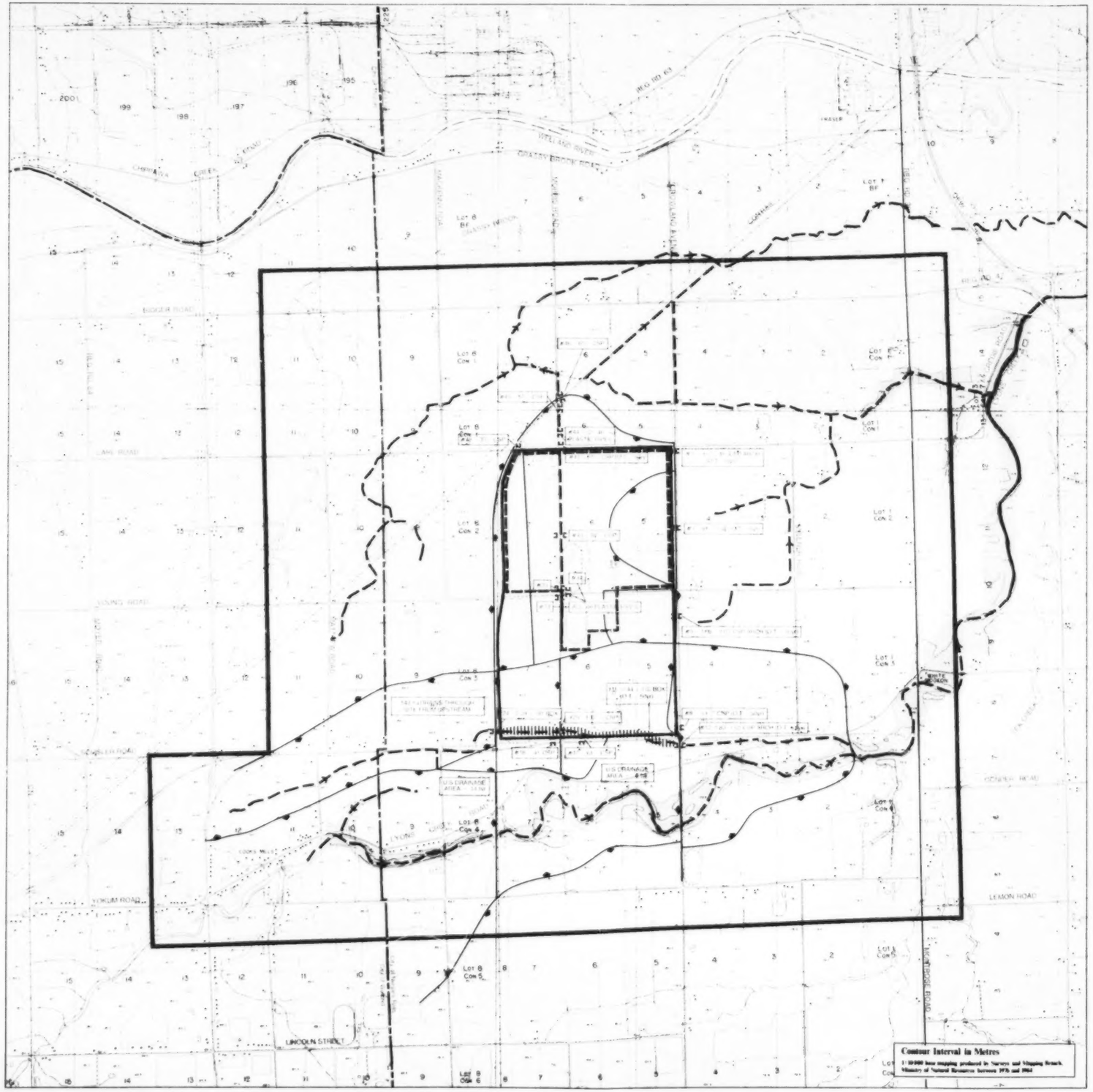
Site LF-1E was considered both as an integrated site and as a partially integrated site. As a partially integrated site the landfill would be located at Site LF-1E with the physical/ chemical plant and incineration plant located at Site PI-27E.

9.1 FLOOD SUSCEPTIBILITY

This site is very flat, with topographic relief of only 1 m. It is considered to be poorly drained, with minimal evidence of on-site drainage swales or channels. Local ponding of water is expected throughout the site during wet weather. The northern three quarters of the site area drains to the north and east while the remaining southern quarter drains to the south. All site runoff eventually drains to the main branch of Lyons Creek by way of several overland flow swales.

The floodplain of the main branch of Lyons Creek, which is located to the east and south of the site, has been mapped by the Niagara Peninsula Conservation Authority as shown on Figure 34. Although the Lyons Creek floodplain extends to within 250 m of the southern boundary of the site, the estimated Regional Storm water surface elevation (174.5 m a.s.l.) is well below the existing grade of the site (180 m a.s.l.). Therefore, the main branch of Lyons Creek is not likely to be a flood threat.

There are no major watercourses to the west or north of the site which could cause serious site flooding.



OWMC Ontario Waste Management Corporation

Consultant:
DILLON
Gartner Lee Associates Limited

Legend:

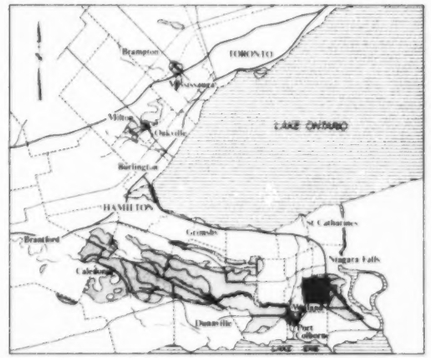
- Regional Storm Floodplain
- Flood-Prone Area
- Channel or Swale
- Watershed Divide
- Culvert or Bridge Crossing
- Crossing Overtopped For Estimated Flow (Inlet Control)
- Corrugated Steel Pipe
- Culvert Identification Number, Size (m) and Type

Note: All Culvert Dimensions in Meters

- Proposed Boundary for Partially Integrated Siting Option
- Proposed Boundary for Integrated Siting Option (Phase 3B Acquisition Boundary)
- Site Vicinity Study Area Boundary

Key Map: LF-1 East

Lots 5, 6 and 7; Concessions II and III; City of Niagara Falls; formerly in the Township of Crowland



1000 feet 0 1000
500 metres 0 500

Existing Surface Water Conditions
PHASE 4A

Surface Drainage: LF-1E

October 1985 FIGURE 34

Residents have indicated that local flooding frequently occurs in the vicinity of the Carl Road/Morris Road intersection. Site visits and analyses of available data indicate that this is due to the very mild ditch gradient along Morris Road and to several undersized culverts that cross this ditch.

A minor flood prone swale flowing beneath Schisler Road was identified from aerial photographic interpretation of the site. However, it was considered to be of little significance to development of this site as a landfill.

Six outlet culverts were identified during field visits. Drainage areas, culvert sizes, flow estimates, etc., at each outlet are shown in Table 32. The culvert numbers (Column #2) are referenced to Figure 34. Comparison of flow estimates with culvert capacities indicates that three of the six outlet culverts would be overtopped by the estimated five year return period storm flow, while the remaining three would be overtopped by the estimated 50 year return period storm flow. Because the site is fairly flat, overtopping is an indicator that inadequate culvert capacity is likely to cause some site flooding in the vicinity of these culverts. However, the severity of the site flooding which this may cause cannot be determined without more detailed topographic data and hydraulic analysis. This should be undertaken in Phase 4B if site LF-1E remains under consideration.

In general, 100 year return period storm peak flow estimates at five of the six outlets are relatively low (0.3 to 4.1 m^3/s) because there is very little upstream area draining to these outlets.

TABLE 32 FLOOD SUSCEPTIBILITY DATA: LF-1E

No. of Outlets	Outlet Ref. # (see Fig. 34)	Drainage Area to Outlet (ha)	Size of Outlet (m)	Capacity of Outlet at: Top of Road (m^3/s)	Capacity of Outlet at: Obvert (m^3/s)	Flow Estimates (m^3/s) Q5 *	Q10 *	Q50 *	Q100 *	Approx. Slopes of Outlet Swales (%)
6	1	7	0.61 x 4.1 Arch	0.31	0.20	0.8	0.9	1.2	1.4	0.25
	3	30	0.60 Ø CSP**	0.51	0.34	1.5	1.8	2.4	2.7	0.25
	5	19	1.67x1.14 Arch	2.56	2.27	1.6	1.9	2.7	2.8	0.17
	8	2	0.53 Ø CSP	0.28	0.23	0.2	0.2	0.3	0.3	0.20
	11	165	2.43x1.07 BOX	7.48	3.85	6.1	6.9	9.2	10.1	0.15
	43	100	0.60 Ø CSP	0.51	0.34	2.5	2.8	3.8	4.1	0.10

* 5, 10, 50, 100 refers to the length (in years) of the return period of the storm under consideration.

** Corrugated Steel Pipe

The estimated flow at Culvert #11 is much larger (10 m^3/s) because of the relatively large upstream area that drains through this culvert (165 ha). However, regardless of the magnitude of the flow estimates, it appears that downstream swale slopes (0.1% to 0.25% based on 1:10,000 topographic mapping) would be inadequate to prevent the backup of floodwater onto the site.

9.2 DRAINAGE IMPROVEMENT CONSIDERATIONS

As with all candidate landfill sites, the existing swales and drainage patterns would be eliminated by facility development The on-site drainage system would be improved by constructing perimeter ditching around the landfill boundaries.

It is proposed that perimeter ditches will collect site runoff and discharge it from the site at the Carl Road/Crowland Avenue intersection. A new channel would be constructed east along Carl Road for a distance of 1,300 m where it would join the existing tributary of Lyons Creek. A further 1,500 m of existing channel (north of Carl Road) may require improvement to convey site runoff to the main branch of Lyons Creek without increasing flood levels. Five structures may require replacement along this route.

Alternatively, control of peak flows from the site to pre-development levels could be accomplished with on-site detention storage. The required storage volume to control 100 year return period storm runoff to pre-development levels is approximately 28,000 m^3.

Interviews with landowners indicate that none of the site is tile drained, and therefore tile drain removal may not be required.

Following discussions among GLAL, and Monenco Limited about on-site surface drainage, it was recommended that the projected storm water outfall be located at the northeastern corner of the site at the intersection of Carl Road and Crowland Avenue. This location is shown on Figures 34 and 35. The stormwater would flow along the road drainage channel to the stream approximately 1,300 m east of the site.

9.3 SURFACE WATER USE

The study area for investigating potential impacts on surface water usage as a result of the various options associated with candidate site LF-1E consists of Lyons Creek, some small tributaries of Lyons Creek and the Welland River (Chippawa Creek) from the confluence of Lyons Creek to the confluence with the Chippawa/Queenston Power Canal (Figure 35).

9.3.1 LOCAL WATER USE

The walk-and-talk program, site tours and meetings with local residents resulted in the identification of several uses of surface water on the site and in the immediate vicinity of the site. The findings of the walk-and-talk questionnaires and site tours are summarized in Table 33 and depicted on Figure 35. Some of the water uses in the site vicinity are relevant to candidate site PI-27E as well.*

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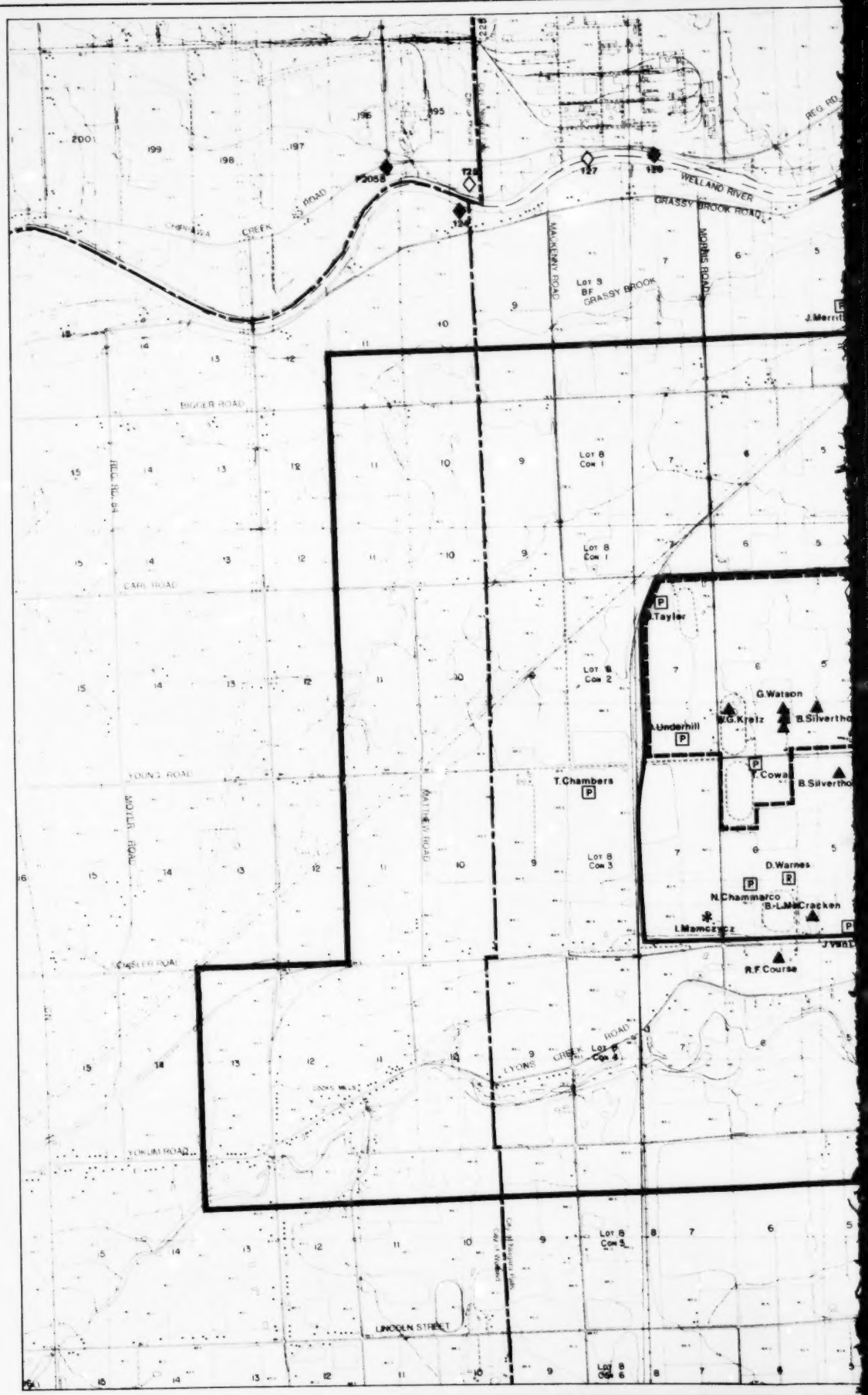
* At the time of the walk-and-talk and other data collecting activities (summer and fall, 1984) the location of the storm water outfall had not been finalized. Consequently, local surface water use data were collected for all the streams downstream from the site. All of the data collected are shown on lcoal surface water use figures of this report. For the purposes of comparative evaluation (GLAL, 1985a), only those uses of surface water downstream from the projected storm water outfall with the site vicinity (study area) were counted.


WELLAND RIVER
GRASSY BROOK ROAD
MAHANEY ROAD
MORRIS ROAD
BIGGER ROAD
CARL ROAD
YOUNG ROAD
MOYER ROAD
CHESTER ROAD
YORKIM ROAD
LINCOLN STREET
LYONS CREEK ROAD
Lot 9 BF GRASSY BROOK
Lot 8 Con 1
Lot 8 Con 2
Lot 8 Con 3
Lot 8 Con 4
Lot 8 Con 5
Lot 8 Con 6
T.Chambers
G.Watson
D.Warnes
N.Chammarco
R.F.Course
L.Mamczycz
A.Underhill
W.G.Kretz
B.Silvertho
T.Cowa
B.-L.McCracken
J.Merrit
J.Tayler
J.van L

OWMC Ontario Waste Management Corporation

Consultant: Gartner Lee Associates Limited

Legend:

- Municipal Intake
- Municipal Outfall
- Industrial Intake
- Industrial Outfall
- Recreation: B - beaches, S - swimming, Bt - boating, W - Winter Sports, P - Pond
- Rural Potable Supply
- Nonpotable Domestic Supply
- Livestock Watering (stream or pond)
- Irrigation - P71 M.O.E. Permit To Take Water
- Farm Pond Unspecified Use or Unused
- Stream Taking - Unspecified Use

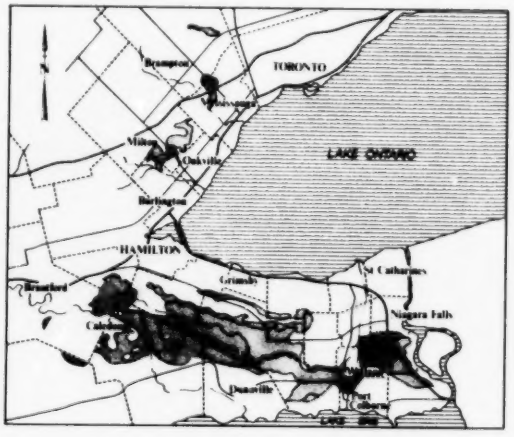
Proposed Boundary for Partially Integrated Siting Option

Proposed Boundary for Integrated Siting Option (Phase 3B Acquisition Boundary)

Site Vicinity Study Area Boundary

Key Map: LF-1 East

Lots 5, 6 and 7; Concessions II and III; City of Niagara Falls; formerly in the Township of Crowland



1000 feet 0 1000
500 metres 0 500

EXISTING SURFACE WATER CONDITIONS, PHASE 4A

Local Surface Water Use

October 1985 **FIGURE 35**

TABLE 33 SUMMARY OF LOCAL SURFACE WATER USE: LF-1E

Individuals Interviewed	Assessment Roll No.	Site (S) or Site Vicinity (SV)	Interview No., GLAL Field Visit No. (FV)	Surface Water Use Comments
R. Butera	14-2-68	SV	120-2	no use indicated
	14-2-68-01			
G. Watson	14-2-59	S	64-1	10 ponds for fish farming
J. Taylor	14-2-67	S	111-1	pond, no use indicated
W. Leishman	14-1-182	SV	23-1A	stream on property, no use indicated
T. Chambers	14-2-25	SV	4-1	pond (old mill pond) no use indicated
V. Mamchych	14-2-14	S	3-1	no use indicated
J. Fekete	14-2-60	S	117-2	no use indicated
Mrs. A. Secco	14-2-177-1	S	20-1	no use indicated
C. Poirier	14-2-30	SV	216-2	stream, no use indicated
G.W. Morris	14-2-10	SV	112-2	no use indicated
	14-2-10-01	SV	112-2	pond, no use indicated
D. Underhill	14-2-60-1	S	116-2	pond, no use indicated
K. Biggar	14-2-89	SV	13-2	stream on property,
	14-2-89-1	SV		
	14-2-136	SV		no use indicated
J. Majoros	14-2-69	SV	29-2	no use indicated
	14-2-35	SV	29-2	
	14-2-70	SV		
	14-1-253	SV		
	14-1-112	SV	29-2	
N. Chammarco	14-2-19	S	10-2	pond on property no use indicated
A. Warner	14-2-115	SV	25-2	no use indicated
	14-2-55	S	25-2	stream on property
	14-2-119	SV	25-2	no use indicated
	14-2-87	SV		
W.G. Kretz	14-2-61	S	9-2	pond taking for livestock operation
J. Van Leur	14-2-15	S	73-2	pond, no use indicated
	14-1-183	SV	73-2	
R. Perrotta	14-2-8	SV	FV 509-G	ponds on property, no use indicated

(cont'd)

TABLE 33 SUMMARY OF LOCAL SURFACE WATER USE: LF-1E (continued)

Individuals Interviewed	Assessment Roll No.	Site (S) or Site Vicinity (SV)	Interview No., GLAL Field Visit No. (FV)	Surface Water Use Comments
J. Morris	14-2-50	SV	71-2	pond, no use indicated
T. Cowan	14-2-18	S	17-2	pond, no use indicated
B. & L. McCracken	14-2-14-1	S	77-1a	pond for livestock operation
R.F. Course	14-1-184	SV	106-1A	stream on property, pond for livestock operation
J.B. Rogers	14-2-22	S	85-1	no use indicated
M. Terreberry	14-2-21	S	79-1	no use indicated
I. Kovaks	14-2-63 14-2-65	S S	113-1a 113-1a	no use indicated
B. Tishler for Frontier Auto Dismantling	14-2-64	S	24-1	no use indicated
W.J. Savoie	14-1-188-2	SV	2-1	stream on property, no use indicated
I. Mamczycz	14-2-23 14-2-23-1 14-2-19	S	11-2	pond used for irrigation
G. Lundy	14-1-173 14-1-173-1	SV SV	677 677	pond and stream on property, no use indicated
Mrs. B. Silverthorn	14-2-10 14-2-17 14-2-50 14-2-53	SV S SV S	245-2	2 ponds for livestock use
D. Warner	14-2-20 14-2-12	S SV	42-2 42-2	pond on property, no use indicated
P. Evans	14-1-185	SV	533-G	no use indicated
J. Colville	14-2-46	SV	715	pond for livestock use
E. Damore	14-2-57	S	28-1	no use indicated
B. Warner	14-2-12	SV	30-2	pond on property, no use indicated

(cont'd)

TABLE 33 SUMMARY OF LOCAL SURFACE WATER USE: LF-1E (continued)

Individuals Interviewed	Assessment Roll No.	Site (S) or Site Vicinity (SV)	Interview No., GLAL Field Visit No. (FV)	Surface Water Use Comments
C. Warner	14-2-50	SV	48-2	no use indicated
	14-2-113	SV		
	14-2-114	SV		
	14-2-47	SV		
	14-2-1	SV		
W. Silverthorn	14-2-52	S	IER#2	no use indicated
A. Delvecchio	14-2-93	SV	267-1	no use indicated
R. Vogt	14-2-99	SV	426	no use indicated
D. Mannell	14-2-83	SV	147-2 FV	ponds and streams on property, no use indicated
D. Pietrangelo	14-2-81-1	SV		no use identified
	14-2-81-2	SV	2131A	pond for livestock operation
Mr. E.F. Hamilton	14-2-75	SV	529-G	pond, no use indicated
M. Cook	14-1-122	SV	66-1	pond, no use indicated
J. Merritt	14-2-126	SV	109-1	ponds and stream on property, no use indicated

The walk-and-talk program did not locate any use of surface water as a source of potable supplies on the site, or in the site vicinity. Surveys indicated that cisterns supplied by rainwater and/or municipal water (trucked in) were the primary sources of potable water to area residents (Site Selection Process Phase 4A: Selection of a Preferred Site(s) - Geologic, Hydrogeologic and Geotechnical Considerations; GLAL, 1985b).

The main use of surface water on site (four locations) was for livestock watering. Surface water was used at a further three locations in the site vicinity for livestock watering. In addition, there are ponds within the site and its vicinity. Ponds are mainly recharged through rainfall and surface runoff. In dry weather some ponds are refilled with stream water.

Livestock watering by direct access to streams also occurs in the study area, e.g. the small tributary of Lyons Creek near the southern limit of site LF-1E. In addition the recreational (aesthetics and fishing) value of Lyons Creek was noted.

9.3.2 REGIONAL WATER USE

Two MOE PTWWs were identified downstream from candidate site LF-1E and/or its alternative access routes (Figures 3 and 35). The PTWW are summarized in Table 34.

TABLE 34 SUMMARY OF PERMITS TO TAKE WATER: LF-1E

PERMIT #	STREAM	PURPOSE	MAXIMUM DAILY AMOUNT (m^3)
P-56	Lyons Creek	Irrigation Golf Course	88.4
P-2019	Welland River	Irrigation	-

Both permits were issued for irrigation purposes. Permit #2019 was issued on the Welland River (Chippawa Creek) for unspecified irrigation purposes. Permit #56 was issued on Lyons Creek for irrigation of a golf course. A second (unpermitted) withdrawal from Lyons Creek for the irrigation of a golf course was identified at the local scale.

The Stanley Avenue combined sewer overflow discharges to the Welland River (Chippawa Creek) between the Chippawa/Queenston Power Canal and the mouth of Lyons Creek. This outfall is the only municipal/industrial outfall between LF-1E and the inlet of the Chippawa/Queenston Power Canal.

The location of the City of Niagara Falls WTP intake listed on Table 25 and is shown on Figure 3. Under normal circumstances, water from Lyons Creek does not flow past this intake. Lyons Creek flows into Welland River (Chippawa Creek) which normally flows west from the Niagara River to the Chippawa Canal. However, occasionally the Chippawa Canal is closed by Ontario Hydro for maintenance work. During this closure the flow in the Welland River (Chippawa Creek) is eastwards and thus the discharge of Lyons Creek would flow past the Niagara Falls intake. The closure is typically for periods of only a few weeks, and occurs approximately once every decade (Personal Communication, A. Wilson, Ontario Hydro, 1983).

This potential pathway to humans was considered to be minor due to the expected low frequency of occurrence of canal cleaning. If Site LF-1E (integrated) or the LF-1E/PI-27E partially integrated option is considered during Phase 4B then this potential pathway should be addressed in more detail with respect to contingency planning.

An indicator of sensitive surface water use downstream from the proposed storm water outfall is made by the DSWUI, presented in Part A of Table 35. This indicator was comparatively low because of the short distance between the stormwater outfall and the Chippawa Canal. The DSWUI for LF-1E is 12.3.

The DSWUIs for the alternative access routes are given in Part B of Table 35. The DSWUIs range from 0 to 63. These values of the Index are for streams between the access routes and potential ultimate receivers - the Chippawa/Queenston Power Canal and Lake Ontario.

TABLE 35 DOWNSTREAM WATER USE INDEX: LF-1E

STUDY AREA	LAND USE			DOWNSTREAM WATER USE INDEX
	WOODED	RECREATIONAL	RURAL	
A. Regional: Stormwater Outfall	0.6	1.5	11.0	13.1
B. Alternative Access Routes: To LF-1E:				
Option 1*	0.0	3.0	19.3	22.3
Option 3	0.0	1.5	11.2	12.7
Option 4	0.1	4.5	29.4	34.0
Option 5	4.8	4.5	28.2	37.6
Option 6	0.0	0.0	0.0	0.0
Option 7	0.0	4.5	30.5	35.0

* These numbers refer to alternative access routes listed in Section 1.6.7.

9.4 ACCESS ROUTES

The Stream Crossing Distance for each of the alternative access routes to Site LF-1E (integrated and partially integrated options) are presented in Table 36.

TABLE 36 STREAM CROSSING DISTANCES FOR ACCESS ROUTES: LF-1E

ACCESS ROUTE	STREAM CROSSING DISTANCE (m)
To LF-1E:	
Option 1*	380
Option 3	100
Option 4	700
Option 5	1,250
Option 6	0
Option 7	480

* These numbers refer to the alternative access routes listed in Section 1.6.7.

9.5 RAIL ACCESS

There is a major railway line (CONRAIL) running along the western boundary of LF-1E. Alignments to the east of the site cross one small stream.

9.6 SUMMARY OF FINDINGS

Flood Susceptibility

- Site LF-1E is characterized by very little topographic relief and is considered poorly drained.

- No part of the site is located on designated floodplain land.

- There is a large upstream drainage area (165 ha) contributing runoff to the site.

- Inadequate outlet culvert capacities may cause some site flooding under existing conditions.

- Outlet swale slopes do not appear adequate to convey run-off from the site without causing a backwater effect. Undersized culverts adjacent to Morris Road, downstream from Culvert #43 will also contribute to site flooding under existing conditions.

Drainage Improvements

- On-site drainage should be conveyed to Culvert #1 at the Carl Road/Crowland Avenue intersection via perimeter ditching.

- The upstream area draining through the site is significant, and if necessary it could be re-routed around the perimeter of the site along Schisler Road.

- A total of 1,300 m of new ditching, the upgrading of the 1,500 m of existing ditching and three structures could be required to provide this site with an adequate outlet, and to ensure downstream water levels are not increased.

- Five downstream road crossings may require replacement.

- Alternatively, on-site storm water management ponds could be used to reduce post-development flows to pre-development levels, reducing or eliminating the need for downstream improvement.

Water Use:

- Local surface water use in the site vicinity is considered to be moderate.
- No surface water is taken for potable or domestic supply on site, in the vicinity or downstream from the stormwater outfall.
- Livestock operators are the most frequent users of surface water on site and in the vicinity.
- Two locations use stream water for the irrigation of golf courses.
- There are recreational uses along Lyons Creek.
- The DWUI is 13.1.

Access Routes

- The Stream Crossing Distances range from 0 to 1,250 m.
- The access route DSWUIs range from 0 to 37.6.

Rail Access

- Major railway line on site boundary.

10.0 CANDIDATE SITE PI-27E
SURFACE WATER CONSIDERATIONS

10.1 FLOOD SUSCEPTIBILITY

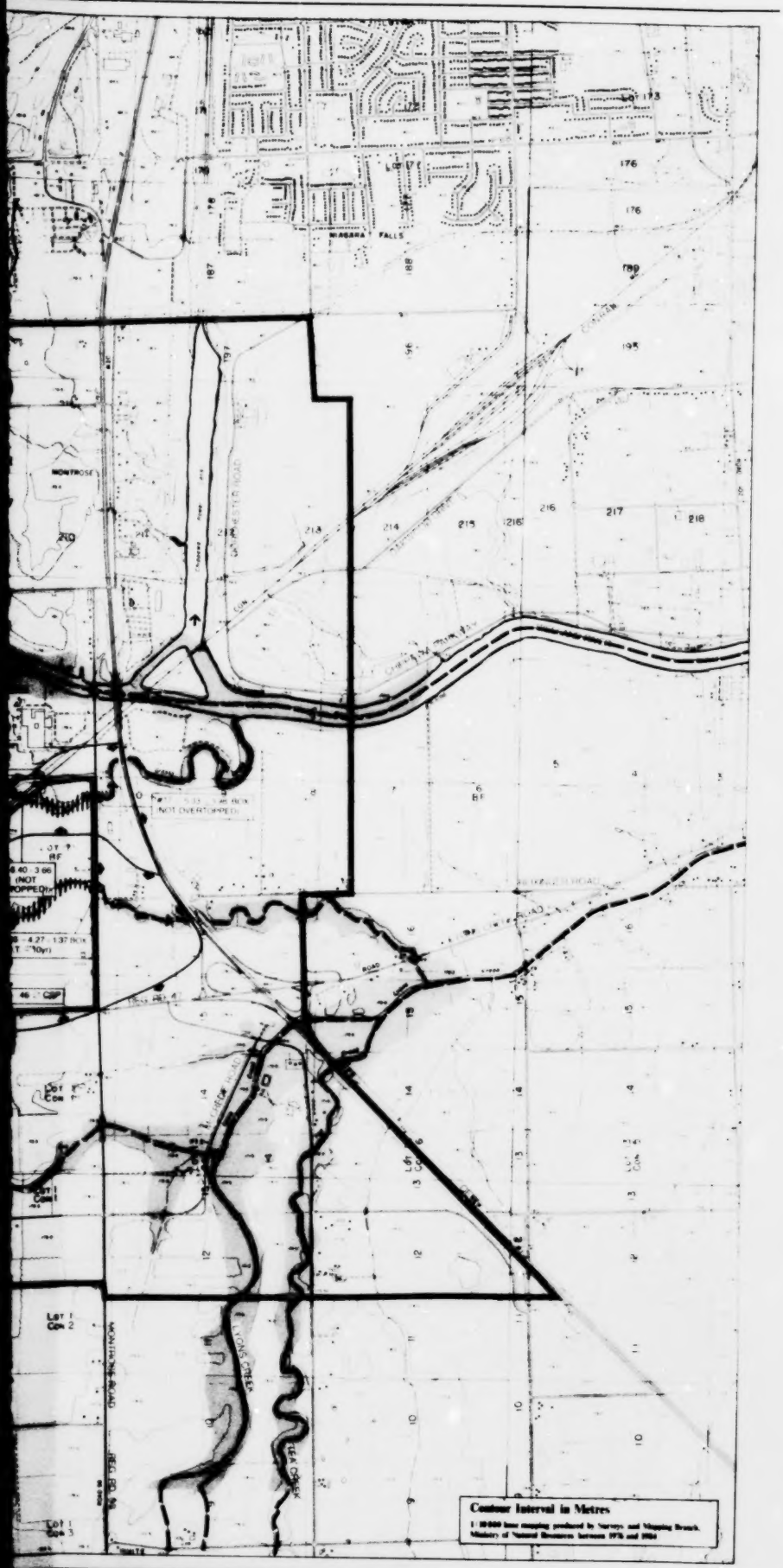
This site is characterized by very little topographic relief, except in the vicinity of two well defined intermittent creeks which traverse the site in a west to east direction. It is expected that the flat land adjacent to these channels is poorly drained.

Both channels that drain the site are tributary to the Welland River. The northernmost channel (Grassy Brook) has its outlet near the Welland River/Chippawa Power Canal junction, approximately 1,000 m downstream from the site. The southernmost channel (unnamed) discharges to Lyons Creek, approximately 1,800 m east of the site. From this confluence Lyons Creek drains in a northeast direction, eventually discharging into the Chippawa Creek (Welland River), approximately 2,000 m west of the Niagara River.

Neither of the floodplains of the creeks which drain through the site have been mapped. However, the floodplains of the Welland River and Lyons Creek outlets have been, as shown on Figure 36. The floodplains for both outlets extend upstream to the eastern boundary of the site.

Both channels draining through the site have been identified from airphoto interpretation as being flood-prone. Detailed hydraulic analysis will be required to determine the

LYON'S CREEK TRIBUTARY
MCLEOD ROAD
YOUNG ROAD
FRASER
MONTROSE
RAILWAY ROAD
Lot 168
Lot 8 BF
Lot 8 Con 1
Lot 8 Con 2
Lot 8



OWMC Ontario Waste Management Corporation

Consultant:

DILLON

Gartner Lee Associates Limited

Legend:

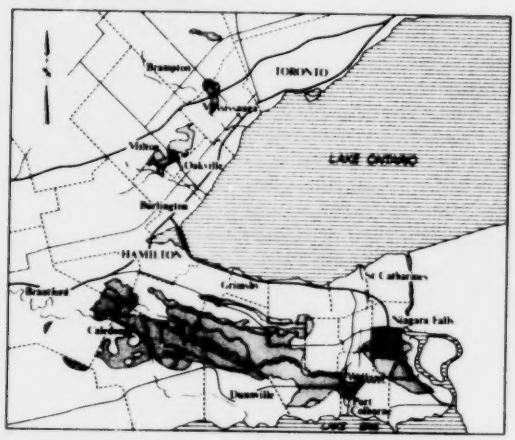
- Regional Storm Floodplain
- Flood-Prone Area
- Channel or Swale
- Watershed Divide
- Culvert or Bridge Crossing
- Crossing Overtopped For Estimated Flow (Inlet Control)
- Corrugated Steel Pipe
- Culvert Identification Number, Size (m) and Type

Note: All Culvert Dimensions in Meters

Phase 3B Acquisition Boundary — Site Vicinity Study Area Boundary

Key Map: **PI-27 East**

Part of Lots 1, 2, 3, and 4; Broken Front Concession Welland River; City of Niagara Falls; formerly in the Township of Crowland



1000 feet 0 1000
500 metres 0 500

Existing Surface Water Conditions
PHASE 4A

Surface Drainage: PI-27E

October 1985 FIGURE 36

extent of flooding associated with these channels, should this site remain under consideration.

Only two outlet culverts were identified during field visits to this site. The drainage areas, culvert sizes and flow estimates are shown in Table 37. The culvert numbers are referenced to Figure 36. A comparison of flow estimates with culvert capacities indicates that roadways at both outlet culverts will be overtopped by the estimated 100 year storm flow. Overtopping indicates an inadequate culvert with a potential for floodwaters backing-up onto the site. However, more detailed analyses will be required to accurately assess the severity of site flooding due to outlet overtopping.

In general, 100 year return period storm peak flow estimates for the site outlets are high (23.6 - 35.5 m^3/s) due to the large (1,883 ha) upstream area contributing runoff through the site. The magnitude of these flow estimates suggests a need for relatively large channels with adequate slope, on, and downstream from the site. However, observation of existing channels and estimates of existing slopes (<0.1%) indicate that flooding is likely to be caused by insufficient channel capacity.

10.2 DRAINAGE IMPROVEMENT CONSIDERATIONS

The high flows and mild channel gradients suggest that substantial improvements may be required to eliminate flooding of site PI-27E. These improvements could take the form of channel improvements, structure improvements, diversions or berming around the proposed facility. However, selection of the most effective and economical solution requires much

TABLE 37 FLOOD SUSCEPTIBILITY DATA: PI-27E

No. of Outlets	Outlet Ref. # (see Fig. 36)	Drainage Area to Outlet (ha)	Size of Outlet (m)	Capacity of Outlet at: Top of Road (m^3/s)	Capacity of Outlet at: Obvert (m^3/s)	Flow Estimates (m^3/s) Q5 *	Q10 *	Q50 *	Q100 *	Approx. Slopes of Outlet Swales (%)
2	16	790	4.3 x 1.4 Box	15.1	9.5	14.0	16.2	21.4	23.6	0.1
	17	1290	5.3 x 2.0 Box	35.6	20.8	21.2	24.4	32.3	35.5	0.1

* 5, 10, 50, 100 refers to the length (in years) of the return period of the storm under consideration

more data and detailed analysis. This analysis should be undertaken in Phase 4B, if this site is considered further. How the facility affects existing site drainage patterns is dependent on its location within the site boundaries. If the facility can be located on higher ground, away from the two channels which drain through the site, then no major effects on local drainage patterns are anticipated.

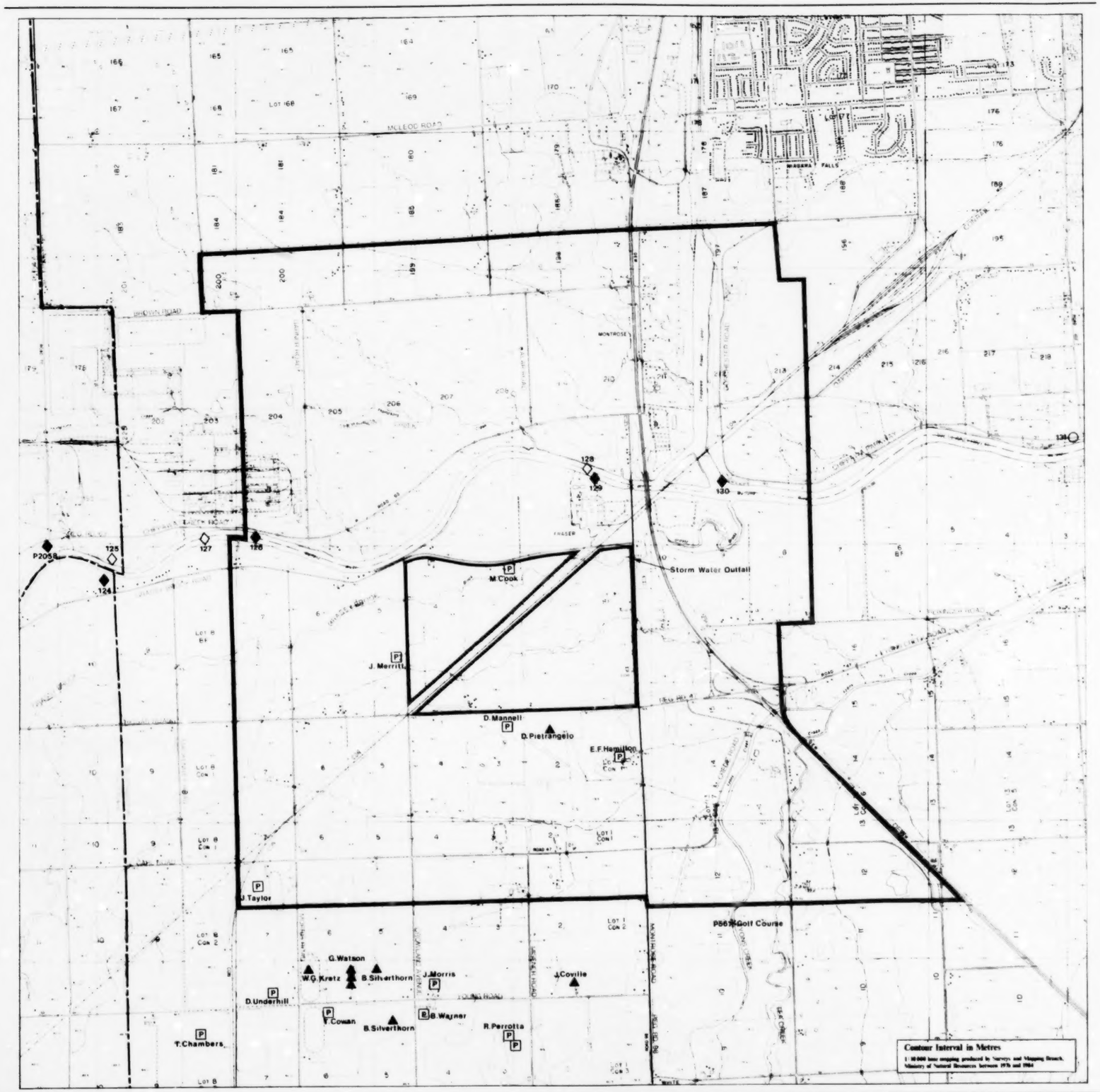
It is expected that existing peak flow conditions will not be significantly increased after the site is developed. Therefore no downstream channel or structure improvements would be necessary.

Interviews with landowners indicate that none of the site is tile-drained and therefore tile drain removal is not likely to be required.

Following discussions between GLAL and Monenco Limited about the on-site surface drainage of the site it was recommended that the projected storm water outfall be located at Grassy Brook where it flows through the northestern corner of the site. This location is shown at Culvert #17 on Figure 36, and on Figure 37.

10.3 SURFACE WATER USE

The study area for identifying surface water uses that may be potentially effected by the development of site PI-27E includes Grassy Brook, Lyons Creek, a small tributary of Lyons Creek and the Welland River, from the north of Lyons Creek to the Chippawa/ Queenston Power Canal. The study area is shown in Figures 3 and 37.



OWMC Ontario Waste Management Corporation

Consultant: Gartner Lee Associates Limited

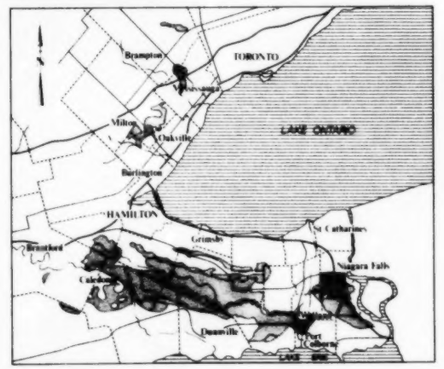
Legend:

- Municipal Intake
- Municipal Outfall
- Industrial Intake
- Industrial Outfall
- Recreation : B - beaches, S - swimming, Bt - boating, W - Winter Sports, P - Pond
- Rural Potable Supply
- Nonpotable Domestic Supply
- Livestock Watering (stream or pond)
- Irrigation - P.T.T.W. M.O.E. Permit To Take Water
- Farm Pond Unspecified Use or Unused
- Stream Taking - Unspecified Use

Phase 3B Acquisition Boundary — Site Vicinity Study Area Boundary

Key Map: PI-27 East

Part of Lots 1, 2, 3, and 4; Broken Front Concession Welland River; City of Niagara Falls; formerly in the Township of Crowland



1000 feet 0 1000
500 metres 0 500

EXISTING SURFACE WATER CONDITIONS, PHASE 4A

Local Surface Water Use

October 1985 FIGURE 37

10.3.1 LOCAL WATER USE

The results of the walk-and-talk program, and discussions with local residents identified a few uses of surface waters on the site and in the immediate site vicinity, Figure 37. The findings of walk-and-talk questionnaires with respect to surface water use are summarized in Table 38.*

No surface water was used as a source of potable water on the site, in the site vicinity or downstream from the projected storm water outfall. The location of the outfall is shown on Figure 37. Domestic and potable water supplies are typically drawn from cisterns supplied by municipal water (trucked in) and/or rain water. Ground water resources tapped through drilled and/or bored/dug wells are either abandoned or used mainly for agricultural purposes because of the hard, sulphurous nature of the water. Some farms within the vicinity of the candidate site were found to have cattle which were allowed direct access to surface water drainage courses. No livestock watering uses were identified on watercourses downstream from Site PI-27E.

The Boy Scouts of Canada operate a camp at the confluence of Grassy Brook and the Welland River (Chippawa Creek). The park is owned by the Municipality of Niagara Falls. The municipality has left the park as a wilderness area at the request of the Boy Scouts of Canada. Surface waters are not used for drinking supplies in the camp. Potable water from the municipal system is trucked in for drinking.

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* At the time of the walk-and-talk and other data collecting activities (summer and fall, 1984) the location of the storm water outfall had not been finalized. Consequently, local surface water use data were collected from all the streams downstream from the site. All of the data collected are shown on local surface water use figures of this report. For the purposes of comparative evaluation (GLAL, 1985a), only those uses of surface water donwstream from the projected storm water outfall with the site vicinity (study area) were counted.

TABLE 38 SUMMARY OF LOCAL SURFACE WATER USE: PI-27E

Individuals Interviewed	Assessment Roll No.	Site (S) or Site Vicinity (SV)	Interview No., GLAL Field Visit No. (FV)	Surface Water Use Comments
E.F. Hamilton	14-2-75	SV	529-G	- pond on property, - no use specified
L. Florentino	13-4-14	SV	41-2	- no use identified
D. Mannell	14-2-83	SV	147-2	- ponds and streams on property
	14-2-95		FV	- no use identified
T. Palatine	13-2-147	SV	284	- no use identified
Mr. J. Merritt	14-2-126	SV	109-1	- ponds and streams on property - no use identified
D. Pietrangelo	14-2-81-1 14-2-81-2	SV	2131A	- no use identified - pond for livestock operation
Mr. J. Stirling	14-2-125	SV	101-1	- no use identified
H.A. Warner	14-2-117	S	93-1	- no use identified
Mr. B. McGarth	14-2-120	S	68-1	- stream (intermittent) - no use identified
M. Cook	14-1-122	S	66-1	- pond & stream on property, no use indicated
C. Warner	14-2-47	SV	FV	- no use indicated
J. Sider	13-4-16	SV	211-1	- no use identified
J. Grassl	14-2-108	SV	183	- no use identified
J. Coville	14-2-46	SV	715	- pond for livestock use
R. Perrotta	14-2-8	SV	509-G FV	- ponds on property, no use indicated
J. Morris	14-2-50	SV	71-2	- pond, no use indicated
B. Warner	14-2-12	SV	30-2	- pond on property, no use indicated
B. Silverthorn	14-2-10 14-2-17 14-2-50 14-2-53	SV SV SV SV	245-2	- 2 ponds for livestock use

(cont'd)

TABLE 38 SUMMARY OF LOCAL SURFACE WATER USE: PI-27E (continued)

INDIVIDUALS INTERVIEWED	ASSESSMENT ROLL NO.	SITE (S) OR SITE VICINITY (SV)	INTERVIEW NO. GLAL FIELD VISIT NO. (FV)	SURFACE WATER USE COMMENTS
G. Watson	14-2-59	SV	64-1	10 ponds for fish farming
T. Cowan	14-2-18	SV	17-2	pond, no use indicated
W.G. Kretz	14-2-61	SV	9-2	pond taking for livestock operation
D. Underhill	14-2-60-1	SV	116-2	pond, no use indicated
T. Chambers	14-2-25	SV	4-1	pond (old mill pond) no use indicated
J. Taylor	14-2-67	SV	111-1	pond, no use indicated

10.3.2 REGIONAL WATER USE

One MOE Permit to Take Water (PTTW) was identified downstream from candidate Site PI-27E. Permit #P2019 was situated on the Welland River (Chippawa Creek) between Lyons Creek and the Chippawa Power Canal. The permit was issued for irrigation purposes. The maximum daily amount allowed was not specified on the permit.

The only other use identified at this study scale was the Stanley Avenue combined sewer overflow which discharges to the Welland River (Chippawa Creek) between the mouth of Lyons Creek and the Chippawa Power Canal.

The location of the City of Niagara Falls WTP intake is listed in Table 25 and shown on Figure 3. Under normal circumstances water from Lyons Creek does not flow past this intake. Lyons Creek flows into the Welland River (Chippawa Creek) which normally flows west to the Chippawa Canal. However, occasionally the Chippawa Canal is closed by Ontario Hydro for maintenance work. During this closure the flow in the Chippawa Creek is reversed and the discharge of Lyons' Creek would flow past the Niagara Falls WTP intake. The closure is typically for periods of only a few weeks, and occurs approximately once every decade. (Personal Communication; A. Wilson, Ontario Hydro, 1983).

This potential pathway to humans was considered to be minor due to the expected low frequency of occurrence of canal cleaning. If siting option LF-1E/PI-27E is considered in Phase 4B then this potential pathway should be addressed in more detail with respect to contingency planning.

An indication of sensitive surface water use downstream from the proposed stormwater outfall is provided by the DSWUI. The DSWUI for PI-27E is 1.6. The values of the DSWUIs for the alternative access routes to PI-27E and between PI-27E and LF-1E range from 0 to 37.6 (Table 39).

TABLE 39 DOWNSTREAM WATER USE INDEX: PI-27E

STUDY AREA	LAND USE			DOWNSTREAM WATER USE INDEX
	WOODED	RECREATIONAL	RURAL	
A. Regional: Stormwater Outfall	0	1.6	0	1.6
B. Alternative Access Routes:				
To PI-27E:				
Option 1*	0.0	0.0	0.0	0.0
Option 2	0.0	0.0	0.0	0.0
From PI-27E to LF-1E:				
Option 1*	0.0	3.0	19.3	22.3
Option 3	0.0	1.5	11.2	12.7
Option 4	0.1	4.5	29.4	34.0
Option 5	4.8	4.5	28.2	37.6
Option 6	0.0	0.0	0.0	0.0
Option 7	0.0	4.5	30.5	35.0

* These numbers refer to alternative access routes listed in Section 1.6.8.

10.4 ACCESS ROUTES

Stream Crossing Distances for the alternative access routes to PI-27E, and between PI-27E and LF-1E appear in Table 40. These distances range from 0 to 1,250 m.

TABLE 40 STREAM CROSSING DISTANCES FOR ACCESS ROUTES: PI-27E

ACCESS ROUTE	STREAM CROSSING DISTANCE (m)
A. To PI-27E:	
Option 1*	0
Option 2	0
B. PI-27E TO LF-1E:	
Option 1*	380
Option 3	100
Option 4	700
Option 5	1,250
Option 6	0
Option 7	480

* These numbers refer to alternative access routes listed in Section 1.6.8.

10.5 RAIL ACCESS

There is a major railway line running through the site (CONRAIL).

10.6 SUMMARY OF FINDINGS

Flood Susceptibility

- Site PI-27E is characterized by poor topographic relief and is generally poorly drained.

- No part of the site is located on designated floodplain land, although both the Welland River and Lyons Creek floodplains extend to the eastern site boundary.

- A substantial area of upstream land drains through the site (1,884 ha).

- Inadequate outlet culvert capacities and insufficient swale slopes could potentially cause site flooding.

Drainage Improvements

- Channel improvements, structure improvements, diversions, berms may be required to eliminate the flooding potential at this site.

- To avoid major relocation of either channel that drains through this site, the facility should be sited on high ground between them, or to the south of the most southerly channel.

- If the two major swales that drain through the site can be avoided, then the effect of the facility on local drainage patterns should be negligible.

- No significant increase in existing peak flows is expected after development; downstream improvements may not be required.

- Storm water ponds will be required to verify water quality prior to discharge to the local stream system.

- The preferred storm water outfall location is in Grassy Brook at Culvert #17.

Surface Water Use

- Local surface water use in the site vicinity is considered to be low.

- No use of surface water for domestic or potable supply was identified.

- Some livestock watering was noted in the site vicinity, but not downstream from the site.

- There was one MOE PTTW for irrigation from the Welland River.

- The DSWUI for PI-27E is 1.6.

Access Routes

- No streams were crossed by access routes to PI-27E.

- The Stream Crossing Distances for alternative access routes between PI-27E and LF-1E ranged from 0 to 1,250.

- The DSWUIs for the alternative access routes range from 0 to 37.6.

Rail Access

- Major railway line on-site.

11.0 REFERENCES

Chow, V.T.
1964: Handbook of Applied Hydrology; McGraw-Hill Book Company. 1418 pp.

Denver
1969: Urban Storm Drainage Criteria Manual; Denver Regional Council of Government, Denver, Colorado, Volume 1, Chapter 3, Section 3.4, March 1969.

Environment Canada
1983: Historical Streamflow Summary, Ontario To 1982, 520 pp.

Gartner Lee Associates Limited and Gore and Storrie Limited
1984: Surface Waters of the Golden Horseshoe as Effluent Receivers (PHASE 3 - INTERIM).

.....
1985a: Site Selection Process, Phase 4A: Selection of a Preferred Site(s): Surface Water; October 1985.

.....
1985b: Site Selection Process, Phase 4A: Selection of a Preferred Site(s): Geologic, Hydrogeologic and Geotechnical Considerations; October 1985.

M.M. Dillon Limited
1977: Storm Drainage Criteria Manual, City of Burlington, Figure 4.1, April 1977 (from Denver, 1969)

.....
1985a: Site Selection Process, Phase 4A: Selection of a Preferred Site(s) - Interim Site Selection Report Candidate Site LF-2N; May, 1985,12 pp.

.....
1985b: Site Selection Process, Phase 4A: Selection of a Preferred Site(s): Transportation; October 1985.

.....
1985c: Site Selection Process, Phase 4A: Selection of a Preferred Site(s): Site Selection; October 1985.

Monenco
1985a: Status Report, Facility Design; October, 1985.

.....
1985b: Site Selection Process, Phase 4A: Selection of a Preferred Site(s) - Engineering; 1985.

Ontario Hydro
1983: Personal Communication, A. Wilson, 1983.

Ontario Ministry of the Environment
1984: Personal Communication, J. Berrendson, Central Region, MOE.

.....
1985: Personal Communication, D. Crump, West-Central Region, MOE.

OWMC
1984: Phase 3 Report Summary; March 1984. 20 pp.

APPENDICES

APPENDIX A - LIST OF AGENCY CONTACTS

APPENDIX B - WALK-AND-TALK QUESTIONNAIRE

APPENDIX C - LIST OF KEY PUBLIC CONTACTS AND SITE INSPECTIONS

APPENDIX A

LIST OF AGENCY CONTACTS

LIST OF AGENCY CONTACTS

AGENCY	TYPE OF CONTACT	DATE
City of Brampton	telephone	May 1984
City of Mississauga	telephone meeting, correspondence	May 1984 June 1984
City of Niagara Falls	telephone	July 1984
Conservation Authorites		
• Credit Valley	telephone correspondence	May 1984 June 1984
• Niagara Peninsula	meeting	May 1984
• Metropolitan Toronto and Region	telephone, meeting	June 1984
Niagara Escarpment Commission	correspondence	May 1984
Ontario Ministry of the Environment		
• Waste Management Branch	correspondence	May 1984
• Water Resources Branch	telephone, meeting	May 1984
• Central Region	telephone, meeting	May 1984
• West-Central Region	telephone, meeting	May 1984
• Halton-Peel District	telephone	July 1984
• Welland District	telephone	June 1984
Ontario Ministry of Natural Resources		
• Central Region	meeting	May 1984
• Maple, Niagara, Cambridge Districts	meeting	May 1984
• Niagara District	correspondence telephone	June 1984 July 1984

LIST OF AGENCY CONTRACTS (continued)

AGENCY	TYPE OF CONTACT	DATE
Ontario Ministry of Natural Resources		
• Water Management Branch	telephone	June 1984
• Conservation Authorities Branch	telephone	May 1984
Ontario Ministry of Transportation & Communications	telephone, meeting	May 1984
R.M. Halton	telephone meeting	May 1984 June 1984
R.M. Niagara	telephone meeting	May 1984 June 1984
R.M. Peel	telephone meeting	May 1984 June 1984
St. Lawrence Seaway Authority	telephone	June 1984
Town of Milton	telephone	May 1984
Town of Oakville	telephone meeting, correspondence	May 1984 June 1984
Town of West Lincoln	telephone, meeting	June 1984

APPENDIX B

WALK-AND-TALK QUESTIONNAIRE

SURFACE WATER QUESTIONS

Interview Identification Number _____

PHYSICAL RESOURCES - WATER

We are interested in the water used on this property: where it comes from, its quality, and how much you use.

1. What is this household's source of supply for domestic water? (e.g. drinking, laundry, toilet)

drilled water	Locate on map with symbol Dr-H
dug wells	Locate on map with symbol Du-H
stream water	Locate on map with symbol * SW-H
cistern	Locate on map with symbol * C-H
bottled water	
municipal main	
other, specify	

2. What is the water supply for the livestock and irrigation on this property?

drilled wells	Locate on map with symbol Dr-A
dug wells	Locate on map with symbol Du-A
streams or dams	Locate on map with symbol * SW-A
cisterns	
municipal main	
other (e.g. ponds)	

3. Are there any streams or ponds on your property?

streams	Yes	No
ponds	Yes	No

4. What can you tell us about the quality of the water?

a) you use or drink? (hard, soft, sulphurous, iron, salty, etc.) _____

_____

_____

_____

b) in the streams or ponds? _____

_____

_____

5. Do the wells, cisterns or streams that you use for water supply ever go dry? If so, how often? _____

_____

_____

6. Can you tell us anything about the construction of the wells? (e.g., when they were drilled, depth, type of pump, name of the driller). _____

_____

_____

_____

7. Has any portion of your property been filled or excavated? If so, please show where on the map. (Locate on map with symbol EV.)

8. Do you know where there are any gas or oil wells on your property or the property you farm - in use or abandoned? Please show their locations on the map with the sybol GW.

9. Please tell us about any problems with flooding in the creeks and streams on your property. Please show locations of the flooded areas on the map. (Locate with symbol FA.)

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_____

_____

_____

APPENDIX C

LIST OF KEY PUBLIC CONTACTS AND SITE INSPECTIONS

LIST OF KEY PUBLIC CONTACTS AND SITE INSPECTIONS

CANDIDATE SITE INTEREST GROUP	TYPE OF CONTACT	DATE
PI-13N	meeting, site tour	July 1984
LF-3C	meeting, site tour, site inspection	July 1984
LF-9C	site inspection	July 1984
PI-13N	site tour, site inspection	August 1984
LF-1E & PI-27E	meeting	August 1984
LF-1E	site inspection	August 1984
LF-4N	site inspection	August 1984
PI-27E	site inspection	August 1984
LF-9C	meeting, site tour	September 1984
PI-1N	site inspection	September 1984
LF-2N	2 meetings, site inspection	September 1984
LF-4N	meeting, site tour	November 1984
LF-4N & PI-1N	site tour	November 1984
LF-1E/PI-27E	meeting	January 1985
LF-9C	meeting	January 1985
LF-3C	meeting	January 1985
ALL SITES	inspection of flooding	February 1985
LF-4N/PI-1N	meeting	March 1985